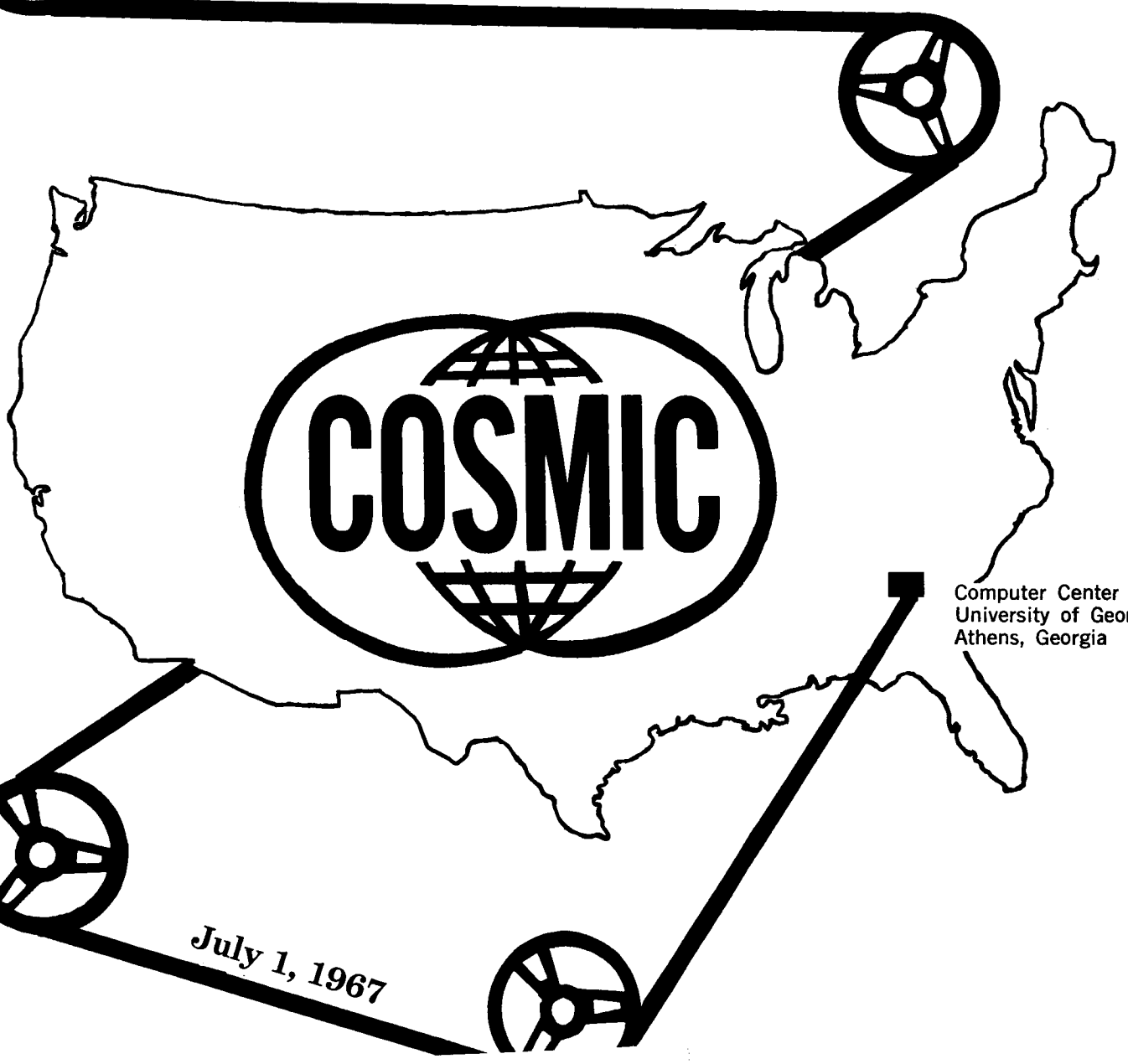
A Directory of Computer Programs Available from COSMIC



Computer Center
University of Georgia
Athens, Georgia

July 1, 1967

VOLUME 1

COSMIC
Computer Center
University of Georgia
Athens, Georgia 30601

DIRECTORY OF COMPUTER PROGRAMS

AVAILABLE FROM COSMIC

July 1, 1967

VOLUME I

N O T I C E

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The Computer Software Management and Information Center (COSMIC), established through the Technology Utilization Office of the National Aeronautics and Space Administration, is completing its first year of operation. To celebrate this anniversary, Volume I of available computer programs has been compiled.

Because much interest is often shown in programs which are not fully operational but contain technical data of immediate use to certain industries, and documentation which is not complete in certain aspects which also contains technical data of immediate use to certain industries, we have divided this catalog into three (3) sections, which are as follows:

SECTION I - Programs which are fully operational and have sufficient documentation to run.

SECTION II - Programs which are fully operational, but with documentation which is not complete in certain aspects.

SECTION III - Programs with adequate documentation, but are missing one or more subroutines. The requestor may obtain these programs, with the option of receiving any missing subroutine when it becomes available. It will be the responsibility of the requestor to advise COSMIC whether or not he has need for the missing subroutine.

PROGRAM FEE:

The Computer Programs (source decks) will be disseminated in tape or card form, depending upon the requestor's preference. The fee for programs, in tape form, is $75.00 furnished on a non-returnable tape. The fee for card form, not exceeding 2,000 cards, is $75.00. Any request for card deck form which exceeds 2,000 cards will be priced by COSMIC on an individual basis since larger programs involve greater expense to process. The program fee includes a copy of the program statements on either a non-returnable tape, cards, or by listing, as desired by the requestor, and program documentation.

Programs ordered on tape, or cards (not exceeding 2,000), may be paid for when order is submitted, or upon receipt of invoice.

DOCUMENTATION FEE:

Documentation may be requested without a program, if desired. The fee for documentation is according to the following scale:

DOCUMENT SIZE	FEE
1 - 25 Sheets	$ 1.50
26 - 50 "	3.00
51 - 100 "	5.00
101 - 200 "	10.00
201 - 300 "	12.50
301 - over	15.00

The fee for documentation is shown as Documentation Fee at the bottom of each page. This fee must be included with your documentation request. For your records, a paid invoice will be included with your documentation.

When requesting programs or documentation for programs, please refer to the Program Number (shown at the top center of each abstract), as well as the title of the program. A quick index is provided which will enable the user to locate specific subject matter. In conjunction with this, an index of program numbers within alphabetic code is supplied.

NOTE: Only Section I contains well documented, fully operational programs.

Section II contains programs which are fully operational, but with documentation which is not complete in certain aspects.

Section III contains programs with documentation, but are missing one or more subroutines.

For additional information, contact:

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SECTION I

Programs Which Are Fully Operational and Have Sufficient Documentation To Run

COS # 890

SCAP-Spectral Analysis of Pulsed-Neutron Decay Data
(Atomics International NAA)

This IBM Fortran II code was written to perform the calculations for the spectral correction analysis of pulsed-neutron decay data. The theory of this new approach and the mechanics of using the code are described in the documentation. The parameters $v\Sigma_a$, D_σ and γ (heat transfer coefficient between moderator and neutron spectrum) are obtained as well as their errors. Also the variation in velocity as a function of buckling is calculated.

The running time is approximately 3 seconds per fit.

LANGUAGE: FORTRAN II

MACHINE REQUIREMENTS: IBM 7090

NUMBER OF CARDS: Approximately 160

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

COS-1260

FIN - A Computer Program for Calculating the Aerodynamic Characteristics of Fins at Supersonic Speeds
(Goddard Space Flight Center)

By numerical solution of Busemann's Second Order Airfoil Theory and the spanwise summing of airfoil strips, FIN determines the pressure coefficient distributed over a given fin configuration moving at supersonic speeds. In determining the distribution, the program can include the effect of fin-tip Mach cone.

From this basic calculation, FIN can determine as functions of angle of attack the lift coefficient, wave drag coefficient, pitching moment coefficient, and center-of-pressure location, and as a function of fin cant angle the rolling moment coefficient. FIN can also determine the lift coefficient slope, wave drag at zero angle of attack, pitching moment coefficient slope, rolling moment coefficient slope, and center-of-pressure location at zero angle of attack as functions of Mach number.

Comparisons with windtunnel data show that predicted values using FIN output fall well within 10% of experiment results.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 250

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

COS-1540

Least Squares Analysis of Variance (LAVA)
(University of Georgia)

The analysis of variance is a widely used statistical technique which facilitates the estimation of a number of variances and provides a procedure for determining significant differences between these estimates. The calculations involved in the case where the cell frequencies are equal or proportional are straight forward and well documented. However, in many areas of research, equal or proportional cell frequencies are the exception rather than the rule.

Disproportionate subclass numbers cause conventional analysis of variance procedures to break down because if the design is not balanced, the effects are not mutually orthogonal. LAVA is a FORTRAN IV program that facilitates the analysis of data that have disproportionate subclass numbers. LAVA is general in that it is applicable to any experimental design with or without covariates. The output of LAVA is annotated and if desired, a mean separation procedure is available to indicate which levels of the main effects are significantly different at the 5% level.

LANGUAGE: FORTRAN IV AND MAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 1250

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

COS-1542

Least-Squares Analysis of Variance (LAVA)
(University of Georgia)

The Analysis of Variance is a widely used statistical technique which facilitates the estimation of a number of variances and provides a procedure for determining significant differences between these estimates. The calculations involved in the case where the cell frequencies are equal or proportional are straight forward and well documented. However, in many areas of research, equal or proportional cell frequencies are the exception rather than the rule.

Disproportionate subclass numbers cause conventional analysis of variance procedures to break down because if the design is not balanced, the effects are not mutually orthogonal. LAVA is a FORTRAN IV program that facilitates the analysis of data that have disproportionate subclass numbers. LAVA is general in that it is applicable to any experimental design with or without covariates. The output of LAVA is annotated and if desired, a mean separation procedure is available to indicate which levels of the main effects are significantly different at the 5% level.

LANGUAGE: FORTRAN AND ASSEMBLY

MACHINE REQUIREMENTS: IBM 360

NUMBER OF CARDS: Approximately 350

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

COS-1560

A General Method for the Computation of Cartesian Coordinates and Partial Derivatives of the Two-Body Problem
(IBM)

This double precision FORTRAN IV program provides a general solution for Cartesian coordinates and partial derivatives of the two-body problem. The compact subroutine allows an accurate and effecient computation of coordinates and partial derivatives for all cases of two-body motion.

The documentation for this program includes derivation of all equations used by the subroutine for those interested in the formulation. A detailed description of the subroutine is also given for those interested in the details of the computation.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 300

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $5.00

COS-1840

Test Scoring And Table Program
(University of Georgia)

This program scores multiple-response tests which have a single correct response for each item, computes test and item statistics, computes the tetrachoric inter-item correlation matrix, and performs a factor analysis and varimax rotation. The point biserial correlation of each item with a criterion score may also be obtained. The number of alternative responses may vary from item to item.

Maximum number of alternative responses per item - 8

Maximum number of items per test - 100

Maximum number of individuals per job - 99,999,999

Multiple scoring keys may be used with the same set of data cards. This feature makes the program applicable for scoring and analysis of the Kuder Preference Record and similarly constructed multi-keyed instruments. In addition, multiple jobs may be run.

LANGUAGE: FORTRAN II, FAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 1,200

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

COS-1850

Analysis Of A Lattice Square Design With K+1 Replications (University of Georgia)

The purpose of this program is to analyze a lattice square analysis of variance with K+1 replications and K^2 treatments.

This program is coded in FORTRAN IV for the IBM 7094 Computer. The only non-standard subroutine used is subroutine ERASE. ERASE is a MAP subroutine whose arguments are A and B. Erase zeroes core between locations A and B inclusive. Fortran statements could be easily included to accomplish the purpose of ERASE, NAMELY zero out arrays.

The program will allow up to 81 treatments arranged in up to 10 squares. The program does some checking of input to assume the identification is within specified limits. There are no error stops built into the program.

LANGUAGE: FORTRAN IV, MAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 350

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

COS-1860

Analysis Of A Lattice Square Design With (K+1)/2 Replications
(University of Georgia)

The purpose of this program is to analyze a lattice square analysis of variance with (K+1)/2 replications and K^2 treatments.

This program is coded in FORTRAN IV for the IBM 7094 computer. The only non-standard subroutine called is subroutine ERASE. ERASE is a MAP subroutine whose calling sequence is CALL ERASE (A, B). Subroutine ERASE will zero out words between the addresses of A and B inclusive. ERASE could be easily replaced with a FORTRAN subroutine to zero out the arrays.

The program will handle up to 81 treatments arranged in up to 5 replications. The program does some checking to insure the identifying information is within specified limits.

LANGUAGE: FORTRAN IV, MAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 350

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

COS-1890

CORPAK
(University of Georgia)

This program, coded in FORTRAN IV for the IBM 7094, computes the following:

1. Sums and Means.
2. Sum of Squares and Cross Products Matrix (Corrected).
3. Partial correlation with up to 39 variables partitioned out.
4. Simple Regression Coefficients and Y Intercepts.
5. Correlation Coefficient Matrix (R).
6. Inverse of R.
7. Multiple Correlation Coefficients.
8. Partial Regression Coefficients.

Within class correlations may be computed by using the partial regression feature of the program.

For a maximum of 100 variables. Expansion for more than 100 variables may be possible by enlarging the dimension statement.

This version of the program requires card input (another version allows input from a data tape with a rewind (or not) option.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 350

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

COS-1892

CORPAK
(University of Georgia)

This program, coded in FORTRAN IV for the IBM 7094, computes the following:

1. Sums and Means.
2. Sum of Squares and Cross Products Matrix (Corrected).
3. Partial Correlation With Up to 39 Variables Partitioned out.
4. Simple Regression Coefficients and Y Intercepts.
5. Correlation Coefficient Matrix (R).
6. Inverse of R.
7. Multiple Correlation Coefficients.
8. Partial Regression Coefficients.

Within class correlations may be computed by using the partial regression feature of the program.

For a maximum of 100 variables. Expansion for more than 100 variable may be possible by enlarging the dimension statement.

This version of the program requires card input (another version allows input from a data tape with a rewind (or not) option.

LANGUAGE: FORTRAN

MACHINE REQUIREMENTS: IBM 360

NUMBER OF CARDS: Approximately 350

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

GSFC-0490

PLOTAN, A Generalized Plot Analysis
Routine for the 7094
(Goddard Space Flight Center)

PLOTAN is a generalized plot analysis routine for the IBM 7094. It was developed to minimize the difficulties encountered in adding plot capabilities to large programs already in existence. PLOTAN is used in conjunction with a binary tape writing routine, WRITER, which produces an intermediate binary tape. PLOTAN then edits this tape, and generates a new tape which may be plotted off line on the CALCOMP 570 digital incremental plotter.

PLOTAN has the ability to plot any variable on the binary tape as a function of any other. This routine does not impose storage problems on the user's program, since it processes the user generated binary tape as either the second link of a CHAIN job or as a separate program. Flexible input techniques for data and axis labeling minimize user programming changes and their associated costly recompilations.

LANGUAGE: FORTRAN IV
MAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: 4,300

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $5.00

LERC-236

Computer Program For Calculating Flow Distribution In A Radial-Inflow Turbine
(Lewis Research Center)

A FORTRAN computer program for flow analysis of a radial inflow gas turbine is given. The program obtains a meridional solution on the mean surface between the blades, followed by solutions on hub, mean, and shroud blade-to-blade surfaces, in a single computer run. Suggestions for modifying the program for use with other types of turbomachines are given. Techniques for overcoming convergence problems are discussed.

The method used is based on an equation for the velocity gradient along an arbitrary quasi-orthogonal between blades and is similar to a method using quasi-orthogonals in a meridional plane. With this method, a streamline analysis can be made for any blade-to-blade stream surface. This surface, if desired, may be assumed to be a surface of revolution generated by a meridional streamline obtained from a meridional streamline analysis on this stream surface a two-dimensional solution for the velocity and pressure distributions is obtained. With several such blade-to-blade solutions, the velocity distribution throughout the rotor passage can be calculated. Simplifying assumptions for upstream and downstream conditions are made for the purpose of readily obtaining a reasonable approximation near the inlet and outlet.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 1,420

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $5.00

LeRC-0281

Computer Program for Computation of Chemical Equilibrium Compositions, Rocket Performance, and Chapman-Jouguet (Lewis Research Center)

A detailed description of a computer program for computations involving chemical equilibrium in complex systems is given in the report. The solution is based on iteration equations for chemical equilibrium computations that are independent of choice of components. The program permits calculations such as (1) chemical equilibrium for assigned temperatures and pressures, (2) theoretical rocket performance for both frozen and equilibrium compositions during expansion, and (3) Chapman-Jouguet detonation properties.

A discussion of some of the problems attendant with the presence of condensed species as reaction products is also given. Some general features of the program are: (1) It requires only sample output; (2) It requires no initial estimates; and (3) It handles up to 15 chemical elements and a total of 90 reaction products including condensed species.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 4,000

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $15.00

MSC-1209

Shield Thickness Calculation Program
(Manned Spacecraft Center)

The Shield Thickness Calculation Program is a FORTRAN IV program which computes the total material thickness from arbitrary dose points located in the midst of shielding geometrics that can be described by multiples of the geometrical solids hexahedrons, cylinders, spheres, hemispheres and cones. Thicknesses are added cummulatively along each radial from each point in terms of equivalent base material thicknesses. The radials about each point are chosen such that they are located in the center of equally sized solid angles. There may be a choice of 80, 320, 720, or 1280 solid angles about each point. Up to six phantom men may be considered by use of internally stored coordinates and may be positioned in any orientation. The arms and legs of each phantom may be independently moved. Thicknesses are written on an output tape for convenience of input to Program L016, which utilizes the cummulative equivalent base material thickness data to compute proton doses at the selected points.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 2900

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $10.00

NPO-10128

Spacecraft Visibility Program with Contour Plotter
(Jet Propulsion Laboratory)

The Spacecraft Visibility Program has two prime objectives: (1) to produce visibility contour plots of all existing DSIF antennas, and (2) to produce visibility contour plots of any antenna configuration at any location in the world to aid in evaluation of proposed antennas and station locations.

The program was developed for the SDS 930 computer of Systems Data Analysis Group located at the Goldstone Echo station. It uses a Benson-Lehner Electro-plotter that has been converted to on-line. The program can be used on other computers because it is written in FORTRAN II, and can easily be adapted for use with other plotters.

LANGUAGE: FORTRAN II

MACHINE REQUIREMENTS: SDS 930

NUMBER OF CARDS: Approximately 500

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

NPO-10130

Structural Analysis and Matrix Interpretive System
(Jet Propulsion Laboratory)

"The Structural Analysis and Matrix Interpretive System (Samis)" was developed to simplify automated structural analysis and to eliminate reprogramming for problem changes. These two objectives are, to some extent, in conflict. They are reconciled by choosing the following programming concepts: (1) whenever possible, standardize, (2) provide a module program, (3) program for intermediate size problems.

Standardization is achieved in this program for output formats, most input formats, error handling, tape handling and formats, and storage assignment. Modularity is achieved by dividing the calculation into a number of tasks which can be performed in the sequence specified by the analyst. A single intelligence system is used. This approach facilitates adding or removing modules from the system. Programming for intermediate size problems is achieved by providing for the use of tapes for data and program storage. To make this operation efficient, tape search is avoided where possible.

LANGUAGE: FORTRAN II or FAP

MACHINE REQUIREMENTS: IBM 7090/4

NUMBER OF CARDS: 21,000

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $15.00

NUC-10046

Digital Computer Program for the Finite Element Analysis of Solids With Non-Linear Material Properties (Westinghouse)

A digital computer program was developed to perform stress analysis and burst speed calculations on axisymmetrical solids. The program produces an easily followed print record containing the displacement of each nodal point of each finite element, the stresses at the center of each finite element, the approximate fundamental frequency of the component, the approximate weight of the component, the average tangential stress within the component and the "burst" speed.

To use the program the axisymmetrical component is first divided into many finite cylindrical elements. Each nodal point of the element is identified by its distance from the axis of rotation and a reference plane perpendicular to the axis of rotation. Each element is identified by its nodal point identification number. A data deck containing the above information together with temperature, load and displacement condition at each nodal point, the angular speed, the pressure at the component boundaries, and the material properties is entered into the computer.

The computer analysis of solids uses a method of successive approximations to solve problems with non-linear material properties. The procedure is based on the repeated solution of a series of linear problems in which the loads and material stiffness are successfully re-defined using the results of the previous solution. The burst speed calculation is achieved by two calculations. The first is perhaps the most basic form of limit analysis for rotating axisymmetrical bodies and is concerned only with the effects of rotation. The second calculation is simply the weighted average tangential stress due to any or all of the effects of pressure, temperature, rotation and acceleration. The second calculation cross-checks the basic program and the calculation of burst speed and provides a comparison of average tangential stress due to rotation and the average tangential stress due to other effects.

(continued on next page)

NUC-10046 (continued)

The computer prints an output that consists of all the input, the displacement of each nodal point, the stress at the center of each element, the approximate fundamental frequency of the component, the average tangential stress due to rotation only, the average tangential stress due to rotation, temperature, and pressure, and the burst speed.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 100

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

MFS-0140

Analytic Nth Order and Partial Differentiation of Algebraic and Transcendental Expressions (University of North Carolina)

This computer program which will generate the derivatives of a given class of algebraic and transcendental expressions has a long history in development. The version on hand was obtained from the University of North Carolina although several universities and industries have contributed to its development. The philosophy is that elementary functions are first transferred in such a way that their derivatives can be obtained simply by successive applications of the basic rules of differentiation.

This flexible program has proven itself useful especially where multiple order differentiation and partial differentiation of involved expressions are desired. In particular, this program has been advantageously employed to solve the rather complex equations of motion involved in a flat earth calculus of variation problem. This resulted from the fact that once the order of differentiation is set up, any given number of expressions may be sequentially differentiated.

LANGUAGE: FORTRAN II
FAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 1100

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

MFS-0143

Computer Evaluation of Ion Engines
(General Electric)

A computer program for the IBM 7090 computer has been developed to numerically calculate the self-consistent space charge flow pattern produced by any given set of electrodes. The program is presently restricted to two-dimensional or to three-dimensional axisymmetric geometries. It was originally developed under Army and later under NASA contract for the solution of ion propulsion problems. However, it is applicable to a great range of other charged particle optical problems--e.g., electron tube design. It is designed to supplant other analog devices such as electrolytic tanks, rubber membranes, and resistance networks.

The method of attack consists of a three-step iterative procedure. First, the Laplace equation is solved for the region in the neighborhood of the electrodes to provide a first approximation to the interelectrode potential distribution. Next, trajectories are calculated for a representative set of particles moving in this assumed potential. From these trajectories, charge densities may be calculated with the aid of the continuity equation. Then the Poisson equation may be solved with these charge densities to give a better approximation to the potential. Three or four such iterative cycles are generally sufficient to give accuracies of the order of 0.1%. A salient advantage of the program lies in its provision for variable mesh size and shape, permitting high resolution in critical regions of rapid field variation.

LANGUAGE: FORTRAN II

MACHINE REQUIREMENTS: IBM 7090

NUMBER OF CARDS: Approximately 4500

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $12.50

MFS-0369

FLO-TRAN: A Program to Automatically Produce Flowcharts of FORTRAN IV Source Decks
(MSFC - General Electric)

The purpose of this program is to automatically produce flowcharts of FORTRAN IV source decks. Additional capabilities include provisions for generating flowcharts from input commands, obtaining program listings, and purpose. The program will interpret and classify the source statements, then process these statements and associated information according to their classification.

FLO-TRAN is an input controlled program designed to provide a means of constructing standardized flowcharts in a minimum amount of time and with minimum effort. It is capable of accepting FORTRAN IV source decks as input and producing descriptive, easily understood flow diagrams as output. In addition to the automatic flowcharting feature, special provisions have been made which enable flow diagrams to be generated from a minimum amount of input information. This makes it possible to form flowcharts of machine language programs as well as many others.

LANGUAGE: MAP

MACHINE REQUIREMENTS: IBM 7094
SC-4020 Plotter

NUMBER OF CARDS: Approximately 5,000

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-0404

Time Controlled Equation Solver
(Boeing Company)

The primary use of this program is as a variable tool in the solution of problems which involve the repetitive use of certain arithmetic, algebraic, and curve-interpolation procedures. Each operation is actually a subroutine, which is called by means of input data cards in the same sequence as specified by the cards. At present there are 27 routines in the program and it is designed to readily accommodate 50 different subroutines.

The user can perform these commonly encountered mathematical operations in any desired sequence on a set of input or generated data. Each calculation is a separate step which the user can perform by specifying the desired operation as input data followed by a list of the parameters which are to be operated on. Although the program has the capability to perform several operations which make it particularly adaptable to the solution of heat transfer problems, it is in no way limited to this type of problem. Also, the process of adding or deleting mathematical operations is a very simple one, requiring only minor modifications to the main program.

LANGUAGE: FORTRAN II
FAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 1930

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $10.00

MFS-0437

BLITZ: An Engineering Tool For Solving Small Problems On The IBM 7094 Computer
(Boeing - Slidell)

BLITZ is a digital computer language which provides the engineer a capability for economically and rapidly programming small problems. It is especially suited to solutions of small problems which would be time consuming if solved manually. Further, the language of BLITZ is simple in structure, and hence is easily learned and used. The BLITZ system is available to New Orleans engineering personnel for problems supporting NASA contracted work.

Specifically, with BLITZ one is able to perform:

(1) Normal algebraic computations.
(2) Evaluations of various algebraic functions, such as sine, cosine, square root, exponential, etc.
(3) Logical operations.
(4) Table lookup; utilize tabular data to evaluate a particular variable as a function of one or two independent variables.
(5) Numerical integration; solve from 1 to 20 first order simultaneous differential equations; or any system of higher order equations which do not exceed the equivalent limit of 20 first order equations.

Since BLITZ is designed for efficient solution of small problems it has certain limitations. Some of these limitations are listed as follows:

(1) Fixed input and output format.
(2) 300 unique symbolic names in any one program.
(3) 3 minutes execution time limit.
(4) Execution of no more than 1000 print statements.
(5) 100 executable BLITZ statements.
(6) Limited use of each BLITZ application number.

LANGUAGE: FAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 5800

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-0441

AMTRAN: Automatic Mathematical Translator
(MSFC Research Projects and Computation Laboratories)

AMTRAN is an automatic-programming on-line, multi-terminal computer system which affords order-of magnitude improvements in programming, debugging and turnaround times over conventional computer arrangements. AMTRAN permits a scientist or engineer to enter mathematical equations in their natural mathematical format as they appear in a textbook and obtain an immediate graphical display of the solution on a cathode ray scope. The system can be used for straightforward problems by a scientist or engineer with no previous computer experience while at the same time, it provides the flexibility required by the experienced programmer to solve nonroutine problems.

The overall objective has been to develop a man-machine interface in which the computer acts as an extension of the human mind, with the closest possible coupling consistent with present technology. To the computer is assigned as much of the rote-mechanical numerical and logical work as possible, forcing the human operator to use his pattern-recognition and other higher mental abilities to greatest advantage. The result is a system which permits the scientist or engineer to use the digital computer to carry out the operations of higher mathematics in the manner in which a desk calculator carries out the operations of arithmetic.

The principal advantages of the system reside, for the nonprogrammer, in the fact that it will accept the natural language of mathematics and that it will give him immediate graphical results. The principal advantage of the system from the programmer's point of view is the ability of the user to program operators or instructions which can be imbedded in other programs to build high-level operators. In addition the system contains high-speed numerical analysis operators. For either class of users, it affords extremely rapid programming and debugging capabilities since a program may be entered and checked out a step at a time.

LANGUAGE: MACHINE LANGUAGE (OBJECT PROGRAM)

MACHINE REQUIREMENTS: IBM 1620

NUMBER OF CARDS: Approximately 650

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $12.50

MFS-0442

Computer Program for Cable Length
vs. Separation Based on Interference
(Boeing)

This program computes interference characteristic numbers in the electric and magnetic modes for each wire in a unit or section of the vehicle. These values are then used to determine which wire bundles contain interferring wire pairs and the recommended wire bundle separation. For bundle comparisions the worst characteristics found within a bundle are taken as the characteristics of the bundle.

This program assumes that: D. C. circuits are not transmitters, circuit susceptibility is independent of the receiver frequency; the frequency used to calculate source characteristics must be less than or equal to 15,000 cps; there is no interference from multiple sources; and a bundle is represented as the worst wire characteristics found within the bundle.

This program is presently limited to 40 wires/bundle and 250 bundles/unit. These numbers may be expanded by slight program modification.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 800

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

MFS-0443

Solution of Compressible Flows in Piping Systems
(Boeing Company)

This computer program will determine the steady state flow of an ideal compressible gas in a piping system. The system may involve orifices, heat exchangers, area changes, constant loss factor elements, adiabatic pipes, non-adiabatic pipes, radius bends, and mitre bends. Known values must include inlet temperatures. Other values which may be known or unknown are inlet and exit pressures, and flow rates in specific branches of the system.

The unknown pressures and flow rates are computed, along with exit temperatures. Total and static pressures, total and static temperatures, and mach number of the flow are computed at each element in the system. Forces on each element and the loss factor for each element are computed together with approximate volume of each series system.

The output data includes the input data, exactly as punched. Computed output values include mach number, static and total pressure, static and total temperature, loss factor, and forces on each element. Output is grouped by series system and includes flow rate and approximate volume, as well as the connecting junctures. The systems for which flow rates are guessed, and the corresponding systems for which the error is computed is output.

Limitations imposed by the program include that the system must be defined by not more than 25 series systems connecting not more than 25 junctures. Three times the number of series systems plus the total number of elements must not exceed 1,000.

LANGUAGE: FORTRAN II FAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 2600

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $5.00

MFS-0465

AMINT: Adams Moulton Integration Subroutine
(Boeing Company)

This subroutine will numerically integrate a set of N simultaneous first order ordinary equations, by either The Adams-Moulton method or the fourth order Runge-Kutta method. It has been checked on several known solutions. In all cases the errors were approximately equal to their expected values and there were no indications that round-off errors accumulate rapidly.

This subroutine offers the user an option of using either one of the following three methods to solve first order differential equations:

(1) A fourth order Runge-Kutta method with a fixed step size.
(2) Adams-Moulton method with a variable step size.
(3) Adams-Moulton method with a fixed step size.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 150

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-0506

Moment of Inertia
(Chrysler)

This program calculates the area, center of gravity, first moment, moment of inertia about two perpendicular axes of any area made up of rectangles, triangles and arcs of circles. It further calculates moments of inertia about the c. g. axis and the principal moments of inertia. Finally by putting in the distances to the extreme points of the area and the applied moment, the stresses will be calculated. Areas may also be subtracted from the figure under question.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7090 (4)

NUMBER OF CARDS: Approximately 150

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-0507

Gain and Phase of Transfer Function
And Matrix Curve Fit
(Chrysler Corporation)

The objective of this program is to compute the transfer function by using a complex matrix curve-fit routine. The transfer function will be used to compute its Gain and Phase in order to check the accuracy of the curve fit. It is also possible to input the transfer function and compute the Gain and Phase.

This program allows the calculation of proper roots, pure real, pure imaginary, or complex conjugates. An additional modification has been made to correct shifts caused by unstable complex roots.

The program will accept input data in root or polynomial form, in the form of gain and phase, gain d. b. and phase, or GR and GI, and w (omega). If the input is of a form other than root or polynomial, the program will compute the transfer function by using a double-precision complex matrix curve fit. The incorporation of the double-precision complex curve fit has greatly increased the accuracy of the curve fit, and, as an additional precaution, the complex portions of the transfer function coefficients have been set to zero on entrance to the root extraction routine.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 1850

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-0508

Frequency and Time Response Package
(Chrysler Corporation)

This program forms a polynomial fraction by multiplying polynomials and adding together the products to seccessively form a numerator and denominator. Either the denominator, or both numerator and denominator roots may be obtained.

Frequency response may be obtained in any or all of three options:

(1) for values of j-omega between a lower and an upper limit, with phase shift between successive points controlled between specified tolerances;

(2) for values of j-omega between a lower and an upper limit, with a specified increment of j-omega between successive evaluations; and

(3) for particular values of j-omega.

The polynomial fraction may also be evaluated for specified complex values of the argument.

The inverse Laplace transformation of the polynomial fraction (time response) may be evaluated within a specified interval of time with a specified increment of time between successive evaluations.

The program has been designed for economy of input and any number of evaluation runs may follow a polynomial input run.

LANGUAGE: FORTRAN II
FAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 2,950

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-0509

Rigid Body Response
(Chrysler Slidell)

This program solves a system of first and second-order differential equations with time varying coefficients, describing the motion of a rigid vehicle.

The Runge-Kutta 4-4 algorithm (as given in NUMERICAL MATHEMATICAL ANALYSIS (5th. Edition), J. B. Scarborough, article 116 (a) and 116 (c)) is used to obtain the solution of the systems of equations. The maximum number of table values allowed for each of the time-varying quantities is 100. At least 3 points must be input for each of the above quantities, even if they do not vary. There are no input tapes. The only output tape is A8 (556 BPI) for the SC-4020 plotter. Cases may be run consecutively; however, each case is independent of any preceding cases, and must contain the full complement of input data.

The program has the facility of noting the maximum and minimum values of each dependent variable during each of a number (up to 100) of "review periods". All input is printed back out for record at the start of a case solution, including tables of the time-dependent quantities.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7090(4)

NUMBER OF CARDS: Approximately 6200*
*Includes plotting subroutine package

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-0551

FORTRAN IV Stereographic Function Representation and
Contouring Program
(North American Aviation-S & ID)

This visual data representation package will generate stereographic drawings, stereographic countour maps and perspective projections. This form of visual data representation significantly increases one's ability to comprehend the nature and structure of complicated functions or data arrays. The package has been programmed as a series of Fortran IV subroutines which utilize the SC-4020 as an output device.

The subroutine package will produce, from ordered or unordered data, any of the following:

1. Stereo or perspective line drawings
2. Flat contour maps
3. Stereo or perspective contour maps
4. A combination of (1) and (3) on the same CRT frame.

Interesting sections of the data may be isolated or highlighted. That is, the programmer may now "fly" through his data if he so chooses, and single out interesting features for detailed stereographic inspection. In typical usage, the package will produce stereo output consisting of about 5,000 line segments in less than a minute.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7090 (4), SC 4020 Plotter

NUMBER OF CARDS REQUIRED: Approximately 5,360*
* Includes plotting subroutine package

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

MFS-0552

Improved Fortran IV Function Contouring Program
(North American Aviation-S & ID)

A numerical technique which results in computer generated contour maps is shown to be useful for studying the nature and structure of functions of several variables. It is especially useful for optimization of complicated functions having two or three independent variables.

The contouring method has been programmed as a group of Fortran IV subroutines which generate output for subsequent plotting by a SC 4020 CRT. In typical applications, about 30 seconds of IBM 7094 time is required to contour a 10,000 point array of data. The programs accuracy and versatility has been demonstrated by generating contour maps of volcanic terrain.

LANGUAGE: FORTRAN IV, MAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 5,000*
*Includes plotting subroutine package

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-0723

RAVAN: Random Vibration Analysis Program
(Marshall Space Flight Center - Computation Laboratory)

RAVAN will perform various statistical analyses of random processes, such as vibration, fluctuating pressure, and on a variety of other phenomena. In addition to basic statistical analysis, the following major functions are analyzed by the RAVAN program: the probability density and distribution functions; the Gaussian and Raleigh functions; the functions of autocorrelation and cross-correlation; the power spectral, cospectral, quadric spectral, and hanned cross-spectral density functions; and the transfer and coherence functions. Tests for stationarity and peak analysis are also given.

Raw data generally are stored on the analog tape and digitized by an analog to digital converter (ADC). However, options are available for punched card input. The upper limit of the Vibration Data Section ADC is 40,000 samples per second. The output from the ADC is processed by the edit program, which monitors the data for errors and places the converted data into the RAVAN input format.

LANGUAGE: SHARE Compiler-Assembler-Translator (SCAT)

MACHINE REQUIREMENTS: IBM 7094
SC-4020 Plotter (Optional)
NUMBER OF CARDS: Approximately 13,000
PROGRAM FEE: $75.00
DOCUMENTATION FEE: $5.00

MFS-1127

Turbine Blade Substitution Imbalance Probability Program
(North American Aviation-Rocketdyne)

A common problem connected with the repair of pump or turbine wheels with damaged blades is the decision regarding the necessity for reblancing after replacement of blades. This program has been generated to provide accurate estimates of the probable imbalance introduced to a previously balanced wheel by replacement of any number of blades from a common stockpile. The resulting information may then be used to avoid rebalancing when necessary, or assure rebalancing when required.

LANGUAGE: FORTRAN IV, MAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 5,300*
*Includes plotting subroutine package

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-1128

Outlier Technique Program
(North American Aviation-Rocketdyne)

This program identifies questionable values in an array of numbers. The program is based on a method which is called the "Full Normal Plot". A description follows:

1. Let $a_{i/n}$ be a typical value for the ith ordered observation in a sample of size n from a unit normal distribution. The choice $a_{i/n} = GAU^{-1}(\frac{3i-1}{3n+1})$, where P = GAU (y) is the cumulative normal, is an adequate approximation to what is claimed to be optimum and is easy to compute.

2. Order the sample of size n to be examined such that $y_1 \leq y_2 \leq \ldots \leq y_n$. Let y' be the median of the y's.

3. For the top third and the bottom third of the ordered array, compute the quantity $Z_i = (y_i - y')/a_{i/n}$. The i's with $(1/3)n \leq i \leq (1/3)(2n)$ are from the formation of Z_i's both because the small values of $a_{i/n}$ promote instability and because Z_i's for such i's seem unrevealing.

4. Approximately (1/3) (2n) of the Z values have been computed. Calculate the median, Z', of the Z's.

5. Special attention should be given to Z values for which both $(y_i - y') \geq AZ'$ and $Z_i \geq BZ'$ where A and B are prechosen constant values.

6. If some or several Z_i values are selected from the above, the Zj's with j more extreme than a selected i also deserve special attention. This is particularly true if the n is small.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 140

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

MFS-1130

Program for Estimating Proposal Weight-Center of Gravity and Moment of Inertia of Rocket Engines and Their Components (North American Aviation-Rocketdyne)

Details of the mechanics and use of an IBM 7090 program designed to allow rapid weight, C. G. and M. I. evaluation of engine or component layouts from a minimum of data input are presented. Each case consists of a composite of assumed common geometrical shapes.

The increasing flow of proposal layouts into the Weight Control Unit for weight, C.G., and M.I. analysis has placed a serious burden on the reduced manpower available. In general, the approach to each of these tasks is identical; i.e., the layout is broken up into parts, each of which takes a standard geometric shape. Values of weight, C.G. and moment of inertia for each part are computed by hand from existing formulas, and the results are then combined. It is the aim of the present program to expedite this process by eliminating this hand-computation.

The general plan of the program requires that each component be resolved into a collection of standard shapes, and that the minimum number of dimensional parameters defining each be submitted as input data. Separate subroutines then process the data for each entry, resulting in a weight, center of gravity, and three properly oriented delta values for each, with respect to a reference coordinate system. The master program then performs all calculations necessary to combine these results into a total weight, C.G. and moments of inertia for the component.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7090(4)

NUMBER OF CARDS: Approximately 2900

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $10.00

MFS-1136

NPREC-Double Precision Arithmetic for FORTRAN
(North American Aviation-Rocketdyne)

The purpose of this program is to enable a FORTRAN programmer to compute in double precision floating point arithmetic. (A double precision number consists of one word for the exponent and two words for the fractions.)

Included are the double precision elementary functions: DPSQT (Square Root), DPSIN (Sine), DPCOS (Cosine), DPATAN (Arc Tangent), DPLN (Natural Log), DPEXP (Exponential).

All double precision variables must be stored in COMMON. A double precision constant must be named as a variable so that it may be stored in COMMON because each double precision number requires three consecutive storage locations (two for the fraction and one for the exponent).

Two sample FORTRAN programs which use NPREC and its associated subroutines are given.

LANGUAGE: FORTRAN IV, & MAP

MACHINE REQUIREMENTS: IBM 7090 (4)

NUMBER OF CARDS: Approximately 2,100

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-1487

Stress Analysis Of Torsional Members Program
(North American Aviation-Rocketdyne)

A digital FORTRAN IV program has been developed to compute the angle of twist per unit length, the components of shear stress at each point, and the magnitude and direction of the principal shear stress at each point in a solid, elastic, prismatic torsional member of arbitrary cross-sectional shape. The program will give only a first approximation to stress concentration factors. However, with problems of an exactly described boundary, the program performs with considerable speed and accuracy. The largest principal stress compares within 1 percent of closed form solutions and curved boundary errors up to 5 percent are introduced as a result of approximating curves by straight lines. The program uses a numerical solution along with finite difference techniques, since it is impractical to attempt a general analytical solution for an arbitrary, simply connected region. Solutions to Poisson's equation have been constructed for a large number of regional shapes which are subject to various boundary conditions. The maximum grid possible using the program is 33 by 65 with a running time of approximately 3 minutes.

LANGUAGE: FORTRAN IV, MAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 6,300*
*Includes Plotting Subroutine Package

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-1488

Torsional Vibration Natural Frequencies Program
(North American Aviation - Rocketdyne)

This program computes the torsional vibration natural frequencies and corresponding mode shapes of a physical system under free vibration, that can be idealized to N lumped mass polar moments of inertia, connected by weightless shafts possessing torsional stiffness. Both free-free and free-fixed end fixities can be accomodated. The method combines the best features of two techniques: the Holzer method and the Stodola method. The latter method obtains the highest frequency which is used for convergence of the Holzer iteration in a reasonable amount of time.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 500

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-1489

Kellogg Piping Analysis Program
(North American Aviation-Rocketdyne)

This is a FORTRAN IV program using the Kellogg General Analytical Method to facilitate the flexibility analysis of rocket engine propellant lines. A stiffness-matrix approach is used as it lends itself naturally to complex configurations in three dimensions. The program accommodates up to 50 curved members and/or straight segments of single runs of piping. Flexibility and stiffness coefficients relating loads and deflections at the free-end are determined. Internal and free-end reactions due to specific free-end deflections can be found, as can internal reactions and free-end deflections due to specific free-end loads.

LANGUAGE: FORTRAN IV, MAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 1400

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-1503

DETERC
(North American Aviation-Rocketdyne)

DETERC is a program to determine Laplace transfer functions of networks. Inputs to the program are of determinants of second order expressions, usually containing L, C, and R of electrical networks or analogous quantities. The program expands the determinants by minors to obtain the numerator and denominator polynomials of the transfer functions. These polynomials are then factored using BROOT as a subroutine. Determinants up to the tenth order (10 x 10) can be used.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 510

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-1506

Propellant Tank Pressurization Analysis Program
(North American Aviation-Rocketdyne)

In developing this program an improved mathematical model was generated which gives consideration to the following:

1. Heat transfer between the gas and the walls, between the liquid and the walls, between the liquid and the gas, between the walls and the insulation, and between the insulation and the ambient

2. Mass transfer within the gas space and at the gas-liquid interface

3. Circulation within the gas and liquid spaces

4. Venting of gas from the propellant tank

5. Propellant tanks of circular or annular cross section, with radius an arbitrary function of axial distance

6. Variation of gas density with temperature and pressure

7. Variation of gas, liquid, wall, and insulation thermodynamic and transport properties with temperature and/or pressure

8. The effects of gas circulation as influenced by diffuser design

The mathematical model was formulated to include many pertinent physical phenomena ignored by hitherto formulated models. This computer program was written to solve the partial differential equations arising from the formulation of the model.

LANGUAGE: FORTRAN IV, MAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 10,000*
* Includes plotting subroutine package

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $15.00

MFS-1513

Gas-Side Heat Transfer Coefficient
Comparison Program
(North American Aviation-Rocketdyne)

This program computes and compares five methods of calculating the theoretical gas-side film coefficient. The five methods are:

Method I	Mayer's boundary layer analysis with properties evaluated at free-stream temperature
Method II	Bartz's simplified analysis with properties evaluated at stagnation temperature
Method III	Bartz's simplified analysis with properties evaluated at film termperature
Method IV	Mayer's boundary layer analysis with properties evaluated at Eckart's reference temperature
Method V	Bartz's boundary layer analysis with properties evaluated at film temperature

The problem faced by the engineer is usually one of determining a realistic value of the gas-side film coefficient. In order to do this, one must compare the various theoretical analyses available. The results obtained by the five most used methods at Rocketdyne and thereby aid him in making a design decision. Also, an important use is that these five CRT curves are readily available for comparison with experimental full scale data.

LANGUAGE: FORTRAN II

MACHINE REQUIREMENTS: IBM 7090 and 7094

NUMBER OF CARDS: Approximately 4,000*
* Includes plotting subroutine package

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

MFS-1633

Column Analysis of Universally Joined Ends
(North American Aviation-Rocketdyne)

This is a FORTRAN IV digital computer program for analyzing a column of variable cross section subjected to externally applied end movements and traverse end leads that lie in two perpendicular planes. The method provides for the computation of the deflection normal to the column axis, the internal moments along the column, and the resulting bending and axial stresses. The three general types of problems which can be analyzed by this program are: (1) determination of the deflections, moments, stresses, and interactions for a specific column due to a single loading condition, (2) constant end moments and axial load which increases to the critical value of load stress, and (3) a column for varying length with constant end moments and a varying axial load.

This program is limited to the field of structures for determining deflections, moments, stresses, and interactions of a specific column, or simply a column to perform a stability analysis of columns.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 300

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-1644

Rocket Engine Exhaust Plume Impingement Program
(North American Aviation - Rocketdyne)

This is a FORTRAN IV computer program used to calculate the point and the angle of impingement of two adjacent rocket engine exhaust plumes. An orthogonal coordinate system between two plumes is defined. A numerical procedure is programmed to locate the point and calculate the included angle between the plumes at the point of impingement. The point is found by traversing the surface of one plume in axial and circumferential increments, and calculating the gap between the plumes at each incremental position. The angle is found by forming the dot product of unit vectors positioned along the velocity vectors of each plume. Tables of the plume radii and plume boundary slopes as function of position along the plume axes are required as inputs to the program.

Checkout of the program is accomplished by comparing the graphical solution to the program solution.

The program is primarily a rocket engine cluster application for exhaust plume studies, with a potential used in the jet engine field involving clustering, and thrust design and analysis studies. It is used for calculating exhaust plume boundaries.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 360

NUMBER OF CARDS: Approximately 740

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $5.00

MFS-1669

Linear System Transfer Function
(Boeing Company)

This program is used to compute the steady-state response of a linear, constant coefficient, second order system to a sinusoidal input over a range of frequencies. It will also solve an auxiliary equation for secondary responses over the same frequency range. The program will accept systems of up to twenty degrees of freedom with forty secondary responses and not limited to any particular physical system, any assumptions will be dependent on the problem which the program is required to solve.

Although the program, as written, will solve any system as specified above, it has been specifically designed for a structural system so the primary responses are normally displacements and the forcing functions are applied forces. The secondary responses are generally either displacements or bending moments. Therefore terminology in this document and in the program is oriented along these lines. When using the program for other physical systems corresponding terms must be substituted by the user.

LANGUAGE: FORTRAN II

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 1,000

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

MFS-1670

System/360 Compatability Subroutines for the SC-4020 Plotter (IBM)

This provides a set of subroutines to assist System/360 programmers in developing grid backrounds, scaling data, and formatting printed material. Although there are many subroutines described in detail, a substantial number are used as lower-level modules for more general subroutines the programmer may never need to call them directly.

Each current SC-4020 output subroutine available to System/360 programmers is listed. The list is divided into three categories to indicate modified, unmodified, and new subroutines. Restrictions required for running on the current system are included. Also included is a listing of special purpose subroutines dealing directly with implementing the SCORS package to the IBM System/360.

LANGUAGE: 360 Assembler

MACHINE REQUIREMENTS: IBM 360
SC-4020 Plotter

NUMBER OF CARDS: Approximately 2600

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $5.00

MFS-1672

Interface Mass Transfer
(Boeing Company)

The purpose of this program is to calculate the mass transfer, either condensation or evaporation, at the liquid-vapor interface. The program can be used for such purposes as a parametric study to obtain an indication of the magnitude of the interface mass transfer in the Saturn VS-IC stage LOX tank.

The method used applies to a saturated liquid which is suddenly pressurized and maintained at that pressure. The LOX is considered as a semi-infinite solid while the vapor is handled in a manner which allows one dimensional fluid flow. Such flow is required if mass transfer is to occur at the interface.

LANGUAGE: FORTRAN II

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 100

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-1673

Step Input Pressure Response
(Boeing Company)

When a disturbance causing a sudden pressure change occurs at one end of a pneumatic transmission line the pressure-time relationship at the receiver end will show an initial time delay as well as transient attenuation or amplification of the compression wave. The ability to predict the relationship between such attenuation of amplification and the transmission line-receiver geometry is useful in sizing the lines and estimating the performance of proposed instrument and control systems.

The purpose of this program is to determine relationships in an instrument volume following a sudden pressure change at the other end of the pressure transmission tubing. Time histories of these pressure responses for tubing of various dimensions, fluid densities, and terminating volumes are found and used to estimate the performance of proposed pressure transmission systems for instrumentation of the Saturn VS-IC stage.

The derivation of the basic equations for transient fluid flow assumes a constant tubing resistance, R. evaluated on the assumption of fully developed laminar flow. It is assumed that the pressure-density relationship in the transmission tube can be approximated by a reversible adiabatic relationship. The pressure and temperature changes are taken to be so small that the density and acoustic velocity can be treated as constants and evaluated at the initial temperature and mean pressure of the system. The basic equations which express the response of a step input pressure are best applied to systems with long, small diameter lines.

LANGUAGE: FORTRAN II

MACHINE REQUIREMENTS: IBM 7094
SC-4020 Plotter

NUMBER OF CARDS: Approximately 3,900*
*Includes plotting subroutine package

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

MFS-1674

Three Dimensional Table Package
(Boeing Company)

The purpose of this package is to provide a simple, flexible means of handling one, two, or three dimensional tables. The tables are read into core, and written back out if desired by certain routines. The tables may easily be changed between data cases. It assumed that all table entries are floating point numbers.

The maximum number of tables that may be used is 99. Linear interpolation/extrapolation is used by the table look-up. Independent variables must be in increasing order.

This TABRD-TLU package is a set of general table-read, table-look-up routines. The calling sequence for TABRD is CALL TABRD (N, TBI, TB2,..., TBN). Thus, there are N+1 variables in the calling sequence; the number of tables, followed by the names of the tables. If more than 99 tables are used, a second calling sequence must be used. TABRD uses subroutine TTTTTT to read the tables, and subroutine TABWRT to write out the tables.

LANGUAGE: FORTRAN II

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 200

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-1675

Orifice Sizing for Fluid Systems
(Boeing Company)

The purpose of this program is to determine the placement and sizes of orifices required to obtain the desired steady state flow rates in a parallel piping system. The system may involve orifices, heat exchangers, area changes, constant loss factor elements, adiabatic pipes, non-adiabatic pipes, radium bends, and mitre bends. Known values must include inlet temperatures. Other values which may be known or unknown are inlet and exit pressures, and flow rates in specific branches of the system. In general, the exit pressures and flow rates should be known. The Mach number and total and static pressures and temperatures are computed at each element in the system. Forces on each element, the loss factor for each element, and the approximate volume of each system are computed.

It is assumed that the fluid is a compressible, ideal gas, that the flow is steady state, and that all elements are adiabatic except heat exchangers and non-adiabatic pipes.

The system must be defined by not more than 25 series systems connecting not more than 25 junctures. The total number of elements plus 3 times the number of systems must not exceed 1,000. The total number of items of data (as illustrated in documentation) may not exceed 4,090. The downstream properties of an element are assumed to be the same as those upstream of the connecting downstream element, thus those diameters must be identical. The number of flows summed to find the flow in a connecting system may not be more than 5. The heat exchanger routine is special purpose and must be coded for the particular type used.

LANGUAGE: FORTRAN II

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 2650

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

MFS-1676

Antenna Voltage Breakdown Study
(Boeing Company)

In the past experiments of voltage breakdown in antennas it was found an antenna seemed to experience voltage breakdown at a lower power level with an input composed of several frequencies than with one frequency. The purpose of this program is to calculate the resultant line voltage on the antenna cable with an input voltage composed of more than one frequency and the line voltage due to a single input frequency. A comparison of the line voltages so produced will give an insight into the development of a technique for predicting the breakdown power levels of multiplexed rf systems. Results for each case include the line voltage expressed as a function of time at intervals of distance over the length of the cable, the calculated line voltage at intervals of time and distance over the length of the cable and the line voltage expressed in polar form at intervals of time and distance over the length of the cable.

Nominally, the input values of distance along the line over which calculations will be made, number of distance increments per wavelength, time increment, and number of input frequencies should be limited according to the specifications listed in the documentation of this program. Detailed information of the limits on input values is also found in the documentation.

LANGUAGE: FORTRAN IV
MAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 330

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $5.00

MFS-1677

Transport Properties of Non-Reacting Gas Mixtures At Low Pressure
(Boeing Company)

This program is applicable for calculations of transport properties of non-reacting mixtures of low-pressure gases. The properties generated are specific heat, viscosity, and conductivity of the individual gas components and the gas mixture, and the Prandtl number of the gas mixture.

Specific heat calculations are valid only in the range of temperatures from 300^0K to 500^0K. The program is good only for a low pressure mixture of gases. The formulas used in this program and other general programming information are contained in the documentation.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 330

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $5.00

MFS-1824

A Digital Computer Program for Passive Network Synthesis
Subject to a Quantized Value Constraint
(IBM)

The program is FORTRAN IV, E-level subset, for the IBM-360, which means that complex arithmetic is not used.

The polynomial factoring subroutine used in 'MULLER' which is in fairly widespread use and therefore will not be discussed further here.

The plot subroutine used in PL360, which is also in rather widespread use.

The function of this program is to synthesize an electrical network, or, more precisely, to determine that combination of element values which yields a close approximation to a desired transfer function denominator for one of the network configurations shown in Figure 1, from which any elements(s) may be deleted. It is the responsibility of the user to determine the tank circuit values which give the desired numerator, and to determine the resistor values which give the desired D. C. resistance. These determinations can be made using conventional network analysis techniques.

The criterion for the selection of a particular set of component values is the summation of the squared differences between the coefficients of the desired transfer function and the corresponding coefficients for the specified component values. In order to minimize the total error, an organized search is made on the undetermined component values. This is done by perturbing individual elements and determining the effect on the total error. When the error has been minimized, subject to the constraints listed below the minimum error is considered to have been obtained. At this point the poles and zeros of the transfer function are computed, and a frequency response of the final transfer function is computed and plotted.

LANGUAGE: FORTRAN IV, E-level subset

MACHINE REQUIREMENTS: IBM 360

NUMBER OF CARDS: Approximately 650

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-1902

Theoretical Performance Calculation
(U.S. Naval Ordinance Test Station)

This computer program calculates the equilibrium composition and temperature of the reaction products following combustion in an engine chamber and subsequent expansion to the exhaust pressure. Simultaneous, non-linear, equilibrium equations for up to 70 reactions products are solved in conjunction with equations for the conservation of atomic species, Dalton's law of partial pressures, and the conservation of enthalpy and entropy. Performance characteristics, such as specific impulse, thrust coefficient, and characteristic velocity; and high temperature thermodynamic properties, such as heat, isentropic exponent, and molecular weight, are part of the program output.

The investigator selects the combustion products he wishes to consider in the combustion process. After selection of the combustion species, gas species are chosen as base gases-one for each combustion element. Four temperatures, T_1, T_2, T_3, and T_4, are input. The first two are used by the program to find the temperature with the required enthalpy. The last two numbers are utilized similarly in the search for the proper entropy. The accuracy required for the temperature guesses is a mild function of the particular chemical element system and the combustion products chosen for study.

LANGUAGE: FORTRAN II

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 1,300

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

MFS-1903

Aerodynamic Heating with Honeycomb
(General Electric)

This program is designed to calculate heat input to, and temperature of, the skins which bound honeycomb structures. The radiation and conduction through the honeycomb, as well as turbulent or laminar heat fluxes to the outside wall are also computed. The skin friction coefficients for turbulent flow are calculated by the Van Driest Solution of Turbulent Energy and Momentum Equations. Laminar skin friction coefficients are obtained from the Blasius' Flat Plate Solution with Eckert's Reference Enthalpy Accounting for Compressibility Effects. The program utilizes initialization and iterative techniques to converge to desired tolerance for inner and outer walls.

Limitations:

1. Table maximums must be observed.
2. Each table must be preceded by a comments card and a control card.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7090(4)

NUMBER OF CARDS: Approximately 520

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-1904

Pipe Stress Program
(Chrysler)

This program is used to calculate the stresses in pipe made up of bends and straights. It is limited to no more than four supports and no more than twenty-nine pipe sections.

The documentation for this routine gives a full description of the method of solution, including equations and mathematical definitions.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 1,920

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

MFS-1909

Supersonic Flow-Cone Solution
(MSFC)

The flow field about a right circular cone impinging upon a gas at super-sonic speeds, may be described by ordinary second-order differential equations. For the case of a zero angle-of-attack, the equation is rather straight-forward and requires only a set of arbitrary initial conditions to be integrated (numerically) to an implicit boundary condition. However, for the small angle solution, initial conditions must come from the zero-angle solution; in addition, one of the variable coefficients involves an indefinite integral, and is most effectively treated as an additional differential equation which is solved simultaneously with the first. Both of these cases are treated by this program. Particular attention has been given to the minimization of round-off and truncation, as the functions are somewhat ill-behaved in certain regions. To this end, the program was coded in double precision, and the integration scheme is optional - the user being able to select either the Runge-Kutta 4-4 or the Shanks 8-12 algorithm.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7090 (4)

NUMBER OF CARDS: Approximately 1200

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

MFS-1910

Heat Transfer-Three Dimensional

This computer program computes the temperature distribution as a function of time in a given body which has been subdivided into a network of nodes. The nodes may by numbered arbitrarily but the program is presently limited to 100 nodes. Methods of heat transfer between nodes may either be conduction, convection, or radiation, and provision for fluid nodes is included. Provision is made for 4 parameters during the solution of a problem. They are specific heat, thermal conductivity, convective heat transfer coefficient, and recover (sink) temperature. Whenever an evaluation of a parameter is needed an appropriate user-supplies subroutine is consulted. Thermal resistances and capacitances may be computed by the program from nodal geometry.

The nodes must be either rectangular parallelopipeds or prisms. Each face of a node must touch only one other node face and their respective surfaces must coincide exactly. Each node must connect with exactly 6 other nodes. In the event that some of the connections are not used, "dummy" connections must be provided to bring the number to six.

The program solves the problem by generating a system of first order differential equations and obtaining an incremental solution by using a method of backward finite differences.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 1400

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-1940

Calculation of Polynomial Coefficients
for Thermodynamic Data
(Marshall Space Flight Center)

This program uses a simultaneous least-squares approximation technique to generate coefficients for polynomials that compute heat capacity, enthalpy, and entropy thermodynamic data as a function of temperature. Since enthalpy and entropy are defined as first integral functions of heat capacity, the simultaneous least-squares technique obtains polynomial coefficients that are the same for all three equations except for the integration constants of the entropy and enthalpy polynomials. The theory and development of this method as applied to thermodynamics are found in NASA TN D-167, Simultaneous Least-Squares Approximation Of A Function and its First Integrals With Application To Thermodynamic Data.

All consecutive runs must be made for the same number of temperature points since the temperature points are read outside of the hoop that reads the thermodynamic data for consecutive cases.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7090(4)

NUMBER OF CARDS: Approximately 5010*
*Includes Plotting Subroutine Package

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-1943

Bottle Blowdown Analysis
(Boeing Company)

The purpose of the Bottle Blowdown Analysis program is to study the thermodynamics of a pressurant in a storage bottle. The pressure, temperature, and flow into or out of a bottle during fill, drain, or standby is computed. Provision is made for deviation from the perfect gas equation of state. The bottle wall is divided into a number of slabs and a one dimensional heat transfer analysis is performed. The bottle may or may not be shrouded with a cooling jacket; if no jacket is present, the environment of the bottle must be definable. The two cases are also identical, the principal difference being that the coolant boiloff rate is of interest in the case of a jacketed container.

The main program does little except input and output and determining which method of computing flow rates is to be used. The actual solutions are obtained by various subroutines.

At the specified time intervals the values of bottle pressure and temperature, amount of pressurant in the bottle, and wall temperature are output. A flow rate into and out of the bottle, the coolant boiloff rate, and the outside film coefficient are also printed.

It is assumed that the outside environment of the bottle is uniform. It is also assumed that flow into or out of the bottle via a piping system is adiabatic. The program requires considerable time when the flow rate into or out of the bottle is computed through a piping system.

LANGUAGE: FORTRAN II

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 1400

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

MFS-1982

Y-Ring Analysis
(Boeing)

The Y-RING Stress Analysis program determines the loads, deflections, slopes, stresses, and moments of the upper and lower fuel and LOX Y-RINGS of the S-IC.

The Y-Ring is a three-way joint at the intersection of the tank skins with the bulkhead and one of the following three components: thrust structure, inner tank, or forward skirt of the Saturn Booster.

A cross section of the Y-Ring is cut at 10 points, generally at points of structural change; with various points being allowed to deflect independently under applied loads. Shears and moments are applied to the cuts in the structure to restore continuity. By changing the configuration of the Y-Ring and observing the effects of the moments and stresses on each shell, an optimum design can be accomplished.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS REQUIRED: Approximately 740

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $5.00

MFS-2058

RTPOLY-ROOT SOLVER

This subroutine uses a modification of Bairstow and Newton-Raphson methods. It will attempt to compute each root within the desired tolerance; if after maximum number of iterations per root it fails to converge, the tolerance for that root is relaxed by a factor of 10. The tolerance for each root is stored in CONV with the corresponding subscript.

The order of the polynomial is limited only by the storage available. The results compare exceedingly well with ROOTZ and the extended precision routines. This routine has been extensively tested and is recommended for general usage in preference to previously used routines.

LANGUAGE: FORTRAN IV AND MAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 180

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-2059

ROOTZ-Root Solver

The available root solvers frequently fail, particularly in cases where the roots are either repeated or clustered. This subroutine provides a means of computing the roots of these polynomials.

Lehmer's Method is used. This method consists of a procedure to search the complex plane in order to locate a neighborhood of desired radium which contains a zero of the polynomial.

The degree of the input polynomial is limited only by the storage available. Approximately 1.5 seconds per root. Note that this subroutine is relatively slow, therefore, its use must be justifiable.

LANGUAGE: FORTRAN IV
MACHINE REQUIREMENTS: IBM 7094
NUMBER OF CARDS: Approximately 260
PROGRAM FEE: $75.00
DOCUMENTATION FEE: $1.50

MFS-2061

Common Business Oriented Language Braille Translator
(Boeing Company)

This is a technique for using COBOL to convert octal character representations into Braille language. This program converts print image tape files consisting of 120 characters per second to Braille cells. This program enables the blind programmer to monitor and evaluate the data generated by his own programs. It enables the blind programmer to be self-sufficient.

This program can be modified to change the computer input requirements. In addition, it can be modified for processing on a character machine. (11-800/1800 is a 48 bit word machine.)

Multiple file reels and multiple reel files are acceptable as input.

LANGUAGE: COBOL

MACHINE REQUIREMENTS: H-800/1800

NUMBER OF CARDS: Approximately 400

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-2071

Frequency Modulation Spectral Analysis Program
(IBM)

Manual methods are not practical for accurately determining the sideband properties of a frequency modulated system involving complex symmetric modulation functions. A technique, utilizing an IBM System/360 Data Processing System, accomplishes the solution with accuracy to four decimal places for an unmodulated carrier amplitude of one.

A Fourier analysis of a frequency modulated wave is easily accomplished utilizing this program.

There are two input requirements for the program which consists of a value for the modulation constant and a sufficient number of observations describing the modulating function so the modulating function is approximately linear between successive observations. It is not required that the interval size be constant over the complete cycle of the modulating function. In evaluating the spectrum, the program divides the modulating function cycle into subintervals whose end points coincide with the observations of the input data. The resulting integration is then performed piecewise in the subintervals. Recognizing that the modulating function in each subinterval is linear, the integration can be accomplished by direct evaluation rather than by an iterative technique.

The accuracy of this analysis technique has been verified using the boundary conditions of sine waves and square waves with various modulating indices. Calculated spectra for the sine wave modulating functions were accurate to at least four decimal places for an unmodulated carrier amplitude of one. Square wave spectra were accurate to six decimal places for an unmodulated carrier amplitude of one. In addition, various complex wave spectra were compared to the actual measured spectra, utilizing a spectrum analyzer to obtain the measured results.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 360

NUMBER OF CARDS: Approximately 180

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

MFS-2073

Bulkhead Fitting Stress Analysis Program
(Boeing)

Bulkhead Fitting Stress Analysis is a shell stress analysis designed for several specific geometry configurations of tank bulkhead fittings for Saturn Boosters. These fittings attach internal or external cylinders or manhole covers to the bulkheads. The cylinders may be capped or uncapped and the manhole covers may be flat plates or spherical shells. Manhole covers may be removed, leaving only the fitting.

Each fitting analyzed consists of a boss ring and from zero to five inter-steps or annular rings. Cylinders and manhole covers may be attached to the ring.

External loading for a shell, fitting, and cylinder consists of pressure, end load and moment or any combination of the three. The end load and moment are concentrated loads transferred through the fitting into the shell. External loading for a shell, fitting, and manhole cover consists only of pressure.

LANGUAGE: FORTRAN II and FAP
MACHINE REQUIREMENTS: IBM 7090/94
NUMBER OF CARDS: 2600
PROGRAM FEE: $75.00
DOCUMENTATION FEE: $5.00

MFS-2080

FORTRAN IV Symbol Mapping Program
(Marshall Space Flight Center)

This program will replace one set of up to 50 variable names in a FORTRAN IV source deck with another specified set of valid FORTRAN IV variable names. The primary use of this program is intended to be the standardization of the variable names in a group of programs.

The names which are to be changed along with the replacement names are fed into the program on $LIST cards. Thereafter, whenever the old name is used in the data program, it is replaced with the new name.

Certain types of FORTRAN statements will not be altered by this program. For instance, FORMAT statements and comments cards are not changed at all, and only the deck name may be changed in a $IBFTC card.

At present, all Hollerith strings in either a CALL or a DATA statement should be checked to see if the length of the string has been altered. The following symbols will not be changed where they have decimal points on either side of and immediately adjacent to them: AND, NOT, OR, LE, LT, GT, GE, EQ, NE, TRUE, FALSE. Blanks are treated as deliminters. That is, split symbols are not identified correctly at the present time.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7090 (4)

NUMBER OF CARDS: Approximately 430

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-2081

Karl and Compare Program
(Boeing-MSFC)

In the process of editing the JPL test data, it was found desirable to compare the reading of each parameter for a particular part against the reading of that same parameter at a previous measurement period. Hence, the Compare Program was written for this purpose.

The Compare Program which calculates the drift between measurements and 90 SORT are used to rank the drifts so that the job of editing will be considerably easier.

The program has one subroutine RANCOD which is used to convert the range codes to integers. The range codes and corresponding integers respectively are: 0-1, 1-2, 2-3, 3-4, 4-5, 5-6, 6-7, 7-8, 8-9, 9-10, --11, and +-12.

The output from the program goes onto UTI which is input to the SORT phase for ranking of the drift. The output is sorted by code, group, parameter and drift. The data is listed after SORT by the program REDWRT.

The output variable are: code, group, item, parameter, latest reading, previous reading, drift, positive drift for SORT.

LANGUAGE: FORTRAN IV
MAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 570

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

MFS-2086

Form Factors Calculation
(Chrysler Corporation)

This program calculates form factors to be used in base heating analysis. The equations are as follows:

$$N = {}^{a}/_{b} \qquad L = {}^{c}/_{b}$$

$$V = \frac{1}{\sqrt{N^2 + L^2 - 2NL\cos\phi}} \qquad W = \sqrt{1 + L^2 \sin^2\phi}$$

$$F_{12} = \left\{\frac{1}{2\pi}\tan^{-1}\left(\frac{1}{L}\right) + V\left(N\cos\phi - L\right)\tan^{-1}V + \frac{\cos\phi}{W}\left[\tan^{-1}\left(\frac{N - L\cos\phi}{W}\right) + \tan^{-1}\left(\frac{L\cos\phi}{W}\right)\right]\right\}$$

Input parameters are as follows:

a, b, c, ϕ (in degrees)

Output parameters are as follows:

a, b, c, ϕ, N, L, F_{12}

These equations provide radiation configuration factors and a quick check on other methods which calculate configuration factors to more complicated configurations.

The timing is a function of the number of cases. A typical run of 10 cases took 1 minute.

All input and calculated parameters are clearly labeled and printed.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 60

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-2087

Three Decimal Semi-Tabular Gaussian Random Number Generator (Chrysler)

This program generates "Gaussian" Random numbers by first generating random numbers of an even distribution from an existing program. These numbers are put into a category by table look-up which assigns a temporary "Gaussian" number from -5.00 to +5.00 in intervals of .05. A second random number from the even distribution is generated and used for a linear refinement to three (3) decimals of the temporary "Gaussian" number.

LANGUAGE: FORTRAN IV, MAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 240

PROGRAM FEE: $75.00

DOCUMEMTATION FEE: $1.50

MFS-2088

Lagrangian Interpolation
(Chrysler)

This program is designed to interpolate values of a polynomial by "fitting" the curve of the polynomial. The method is based on the Lagrange interpolation formula. This formula provides the equation of a polynomial of degree n which takes on n + 1 specified functional values when x takes on the values x_0, x_1, ...x_n.

Special Considerations or Restrictions:

1. The value of x as input cannot be less than x_1 in the table of values. Likewise the value of x_{fin} cannot exceed x_n in the table of values.

2. The table of values must be read in the following order: x_0, y_0, x_1, y_1, x_2, y_2, ...x_n, y_n, such that $x_0<x_1<x_2$ ...$<x_n$.<

Timing:

Typical run approximately 2 minutes.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7090 (4)

NUMBER OF CARDS: Approximately 80

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-2089

Approximate Thermodynamic, Transport and Electrical Properties of High Temperature Air.
(Chrysler)

The thermodynamic, transport and electrical properties of air are computed using pressure and temperature as inputed independent variables. A table of computed dependent variables, described below, will be generated. Computation will be made on all values of temperature for each value of pressure.

Timing: A run was made with 21 values of pressure and 63 values of temperature in approximately 3 minutes.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7090 (4)

NUMBER OF CARDS: Approximately 430

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-2091

A Routine to Obtain A Time Response of an "N" Order Transfer Function to any Desired Input
(North American Aviation-Rocketdyne)

A general purpose digital routine of linear equations application to solve time response of an "n" order transfer function to any desired input, and determine the effect of sample time on the digital solution.

Transfer function polynominials are read from lowest to highest numerator, then lowest to highest order for denominator. Function FGEN and Delta T calculation intervals are required for input application.

The time response of a predetermined transfer function can usually be obtained for "standard" inputs, through use of Laplace transforms, but when the responses of higher order transfer functions to complex inputs are desired, computations can become impractical. Analog computer mechanization will generally provide a means of obtaining the desired results, but in order to provide the additional method of solution on the digital computer, as well as to determine the effect of sample time on the digital solution, a routine that obtains a time response of an "n" order transfer function to any desired input has been written.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7090

NUMBER OF CARDS: Approximately 4830*
*Includes Plotting Subroutine Package

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-2093

Drift Minimum Altitude Control Gains
(Chrysler)

The program involves massive calculations of time varying quantities in solving two sets of equations with two time varying unknowns. It is written such that any number of runs may be run at one time. The test problem can be run in approximately one minute.

For input data the program use such as the following:

1. Number of time points.
2. Angular velocity.
3. Diameter of vehicle.
4. Distance from Gimbal Point to accelerometer location.
5. Time point.
6. Thrust.
7. Moment of Inertia.
8. Drag.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 330

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-2094

Polynomial Fraction Evaluation With
Frequency Response Option
(Chrysler Corporation)

This program takes as input sets of polynomial fractions representing the transfer functions of electrical and mechanical systems; F(S) = A(S)/B(S) is computed, where A(S) and B(S) are each the sum of the product of sets of polynomial fractions. No polynomial can exceed 50th degree.

F(S) is computed and printed along with the roots of P1, P2, P3, and P4. Frequency response for F(S) may be computed and printed in the following format: j omega, X, Y, R, Theta, and log R to base 10.

LANGUAGE: FORTRAN II

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 1750

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-2095

Flow-Charter
(General Electric)

The objective of this program is to produce flow charts of programs written in FORTRAN IV or FORTRAN II. Charts are produced directly from the source deck by loading FLOW-CHARTER and the program to be charted on tape and running the program on the IBM 7090 (4) computer.

Considering the time and effort involved in manually drawing charts, this program produces a quality product at minimum expense. The detail of the charts allows the programmer to easily construct a higher-level logic diagram. It is also a handy debugging tool, since charts may be produced at any time to help in studying the program steps and their logical relationships.

The FLOW-CHARTER scans each card for breaks in logic which are specified by the following type statements:

(1) DO Statements
(2) unconditional GO TO Statements
(3) computed GO TO Statements
(4) assigned GO TO Statements
(5) ASSIGN Statements
(6) arithmetic IF Statements
(7) logical IF Statements

Sequential cards are grouped within one block until a break in logic is detected.

The lines to the left of the statement boxes show the ranges of DO loops, to a maximum of 10 nested DO's. The lines to the right of statement boxes trace lines of flow, based on arithmetic and logical IF statements, as well as assigned, computed and unconditional GO TO statements. A maximum of 15 different flow lines may be handled simultaneously.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7090 (4)

NUMBER OF CARDS: Approximately 600

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-2096

Heat Transfer, 1-D

This program will compute a temperature-time relationship in a one-dimensional model, subject to certain fixed boundary conditions. The model must be of constant cross-section, and must be divided into parts such that each part may be considered to be concentrated at its mass-center, or node point.

Heat transfer from node to node along the model, may be either by conduction or radiation, as defined by the input data. The radiation capability is included to account for gaps in the model (between nodes).

The boundary conditions are as follows: At one end, heat is admitted by convection from a "sink" temperature, Tr, with a convection coefficient, h. Both h and Tr may be functions of time, in which case they are input in tabular form. In addition to the heat which flows between this end node and the one second from the end, radiation from the node to "free space" (a constant "sink" at $0^{o}K$) can be taken into account as a program option.

The node at the other end of the model is insulated. The method used is that of "backward" finite differences, a method which enables the temperature profile at a given time point t_{i+1} to be determined from conditions at the previous time point ;t_i, by solving a system of simultaneous algebraic equations. This method has the important advantage of being inherently stable.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 550

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

MFS-2097

Frequency Counts of Gaussian Random Numbers
(Chrysler)

This program obtains frequencies of Gaussian Random Numbers with various sigma values. It uses the equations:

$$K_j = +C(j-1)$$

$$P_j = -C(j-1)$$

where j = 1, 2, 3, ...T and t is one half the number of intervals to be calculated; C is the width of the intervals.

After determining the limits K_j and P_j of each interval, random numbers are generated using a subroutine. A count is made in each interval to determine the total number of random numbers falling in that interval.

Special Restriction:

Maximum number of random numbers generated - 10,000
Standard deviation - 2 (maximum)

One minute was required to find the randomness of 5,000 numbers.

LANGUAGE: FORTRAN IV,
MAP

MACHINE REQUIREMENTS: IBM 7090 (4)

NUMBER OF CARDS: Approximately 220

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-2098

Second Order Shock Expansion Theory
(Chrysler)

This program determines local aerodynamic flow parameters of various missile shapes on which supersonic flow exists over the body.

This program is set up to handle angles of phi which are loaded as distinct values or as an increment. The number of times phi is incremented will be an input item within the program. The above input item will also designate the number of distinct values of phi to be loaded.

Timing is a function of the number of bodies to be examined. A sample problem pertaining to three sections required 3 minutes.

The angle of attack and aerodynamic flow parameters are printed in tabular form for each section.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7090 (4)

NUMBER OF CARDS: Approximately 540

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-2099

Windblow: Wind Generation Program
(Chrysler)

WINDBLOW is a wind generation program which generates pseudo-random normally distributed winds properly conforming to the input means, standard deviation, auto-correlation and cross-correlation matrices. It has the capability of generating "spikes" at the highest or lowest altitude, the "spike" falling within the "band" of a double-truncated normal distribution, the wind vectors at all other altitudes being properly correlated w i th the wind vector defining the "spike". Other capabilities include (1) rotation of the axes to which the means, standard deviations, and correlation matrices are referred, (2) suppression or scaling up or down the elements of the correlation matrices.

The input arrays (auto-correlation, cross-correlation, means, and standard deviations) are standard in this program; however, there are several optional capabilities by which the arrays are altered. The input arrays can be truncated at chosen lower and/or upper levels of altitude. The arrays may be rotated about their axes through a given angle. Any element of the auto-correlation matrices may be suppressed, i.e. set to zero.

LANGUAGE: FORTRAN IV, MAP

MACHINE REQUIREMENTS: IBM 7090 (4)

NUMBER OF CARDS: Approximately 1140

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-2100

Interpolation Routine for m Curves
with n Known Values on Each Curve
(Chrysler)

This program utilizes matrix notation to interpolate on m curves having n known values to give p values as a solution for each curve. The input matrix of the ordinates is premultiplied by cubic and parabolic operator matrices constructed from the vector of the known abscissae and by a multiplier matrix constructed from the vector of the abscissae of the desired interpolated values.

Restrictions:

1. The input curves must be unique.

2. The input vectors must be monotonic. They may be either increasing or decreasing, but both must be the same. Also, the values of the interpolative abscissae must fall within the range of the known values.

3. Maximum number of curves is 26. Maximum number of known values is 26. (Minimum is 3.) Maximum number of interpolated values is 100.

The input vectors, along with the matrix of known coefficients, are printed out, followed by the interpolated values for each curve.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7090 (4)

NUMBER OF CARDS: Approximately 340

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-2102

Shroud Separation
(Marshall Space Flight Center)

This program is used to analyze the position of a shroud that is jettisoned from the Saturn 1_B/Centaur. The mathematical model considers effects of locating the jettisoning thruster in various positions on the shroud. The equations of motion for the shroud are derived assuming in plane motion.

The first and second order integration formulas of Runga-Kutta technique were used to evaluate the first and second order differential equations listed in the definition of the problem.

Timing is dependent on the integration interval, time step size, and the number of consecutive cases to be run. For an integration interval of 0 to 7 seconds and a time step of .05 seconds, 15 consecutive cases required 2.5 minutes of IBM 7094 computer time.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7090 (4)

NUMBER OF CARDS: Approximately 5020*
*Includes plotting subroutine package

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-2104

Power Spectral Bending Moment Program for a Rigid Vehicle (General Electric)

The program computes vehicle response to atmospheric turbulence through a power spectral program. Cramers rule is used to obtain the frequency response function where the maximum polynomial is a quartic. The output power spectrum, the spectrum of bending moment, exceedances, sigmas, and probabilities are computed.

Four degrees of freedom are considered. These are lateral translation, rotation, angle of attack, and swivel engine angle. The effect of control sensor gains are determined by the ratio of specific control gains to the attitude control gains. This enables the determination of optimum gain ratios as effecting gust response of a rigid vehicle.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 6340*
*Includes plotting subroutine package

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-2106

Pressure Vessel Program
(Chrysler)

The program considers a given flow of gas into the pressure vessel, a compressible flow of the gas through an orifice out of the vessel, and heat influx through the vessel to the gas. It is capable of computing the required orifice diameter for a flowrate either given or calculated as a function of downstream reservoir parameters; or computing the flowrates resulting from a given diameter orifice. Program options may calculate, as a function of time, the following: gaseous flowrate through an orifice into the container, container volume, and outlet orifice size. The program may also consider a composite container wall of two materials. The thermodynamic properties of the gas being used are determined by use of the Beattie Bridgeman equation of state and conversation of energy equations. Conductive heat transfer through the walls of the container is calculated by the method of finite differences. The surface film coefficients are calculated by consideration of free convection.

Computer run time is a function of begin time, stop time, and the time increment. A test run from 0 to 150 seconds with a time increment of .2 seconds ran for three minutes.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7090 (4)

NUMBER OF CARDS: Approximately 760

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

MFS-2107

Gas Generator Combustion Program
(General Electric)

This is a general combustion program that simulates the combustion of a rocket propellant in the combustion chamber and simulates the flow of chemical products through the nozzle throat into the nozzle exit area. The program is flexible enough to use any of the rocket fuels now developed and can be readily expanded to include fuels developed in the future. It is assumed that the combustion process in the chamber occurs isenthalpically at constant pressure as determined in the combustion chamber. Gas generator combustion products analyzed from test samples have been included, and their thermodynamic data are generated by polynomials as a function of temperature. The results of this program consist of the performance parameter calculation and the thermodynamic data in the nozzle exit area.

The mathematical model is a complex system of non-linear equations that represents the combustion and expansion process of a burning propellant. The basic equations are: the chemical-equilibrium equations, the mass-balance equations, the pressure equation, the entropy equation, and the enthalpy equation. These equations are solved simultaneously using a special technique developed at Lewis Research Center in Cleveland, Ohio. Basically, the non-linear set of equations is converted into a linear set by rewriting the equations in LOG_e form and the linear set is solved by using the Newton-Raphson Iteration Technique. The Lewis technique represents the equations in a special matrix form; then by utilizing properties of matrix algebra, the system is reduced to an augmented matrix representing the number of gaseous atoms, the pressure equation and either the enthalpy or enthropy equation. The gauss method is used to solve the equations represented by the augmented matrix and this solution is used to determine the values of the gaseous molecules. This process is repeated until the solution iterates to a specified tolerance.

LANGUAGE: FORTRAN IV, MAP

MACHINE REQUIREMENTS: IBM 7090 (4);
SC-4020 Plotter (Optional)

NUMBER OF CARDS: Approximately 6,450*
*Includes plotting subroutine package

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $5.00

MFS-2108

Conversion Tables
(Chrysler)

The purpose of this program is to generate eight different conversion tables; they are:

A. Conversion from PSI to N/CM2. (1-P-4000)

B. Conversion from N/CM2 to PSI. (1-N-3000)

C. Conversion from PSI to Millibars. (.1-PO-15)

D. Conversion from Millibars to PSI. (1-M-1100)

E. Conversion from Feet to Meters. (1-F-240,000)

F. Conversion from Meters to Feet. (1-M-73,150)

G. Conversion from Centigrade to Fahrenheit, Kelvin, Rankine. (-273-C-2000)

H. Conversion from Fahrenheit to Centigrade, Rankine, Kelvin. (-459-F-3,600)

This program contains an option as to which table will be generated.

The output has been arranged such that the tables can be printed on 8 1/2 (Horizontal) by 11 (Vertical) Multilith paper.

Timing: 1.5 minutes for each table desired.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7090 (4)

NUMBER OF CARDS: Approximately 210

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-2109

General Least Squares Solver of Linear Equations
(Chrysler)

This program gives the least squares solution to a system of overdetermined linear equations BX=C, where B is on NxM matrix with N≥M and C a column vector of dimension N. A maximum of 100 equations in 24 unknowns may be used.

Time for a typical run is from a minimum of one minute to a maximum of four minutes. The output consists of the program title printed as the main heading, print-out of the augmented matrix by rows, then a print-out of the solution by rows.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 90

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-2110

Linear Matrix Equation Solver
(Chrysler)

This program, using double precision, will solve N linear equations with N unknowns. The method used is Cramer's Rule.

The criterion for a system not having a root, is that the absolute value of the denominator's determinant be less than .IE-6. This means that the denominator may have a non-singular determinant but it is insignificantly small.

A 9 by 9 matrix takes 2 minutes of computer time.

The output consists of the program title printed as the main heading, the input matrix printed out by rows, and the value of t the unknown along with the row number the unknown is located in.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7090 (4)

NUMBER OF CARDS: Approximately 90

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-2111

Linear Algebra
(Chrysler)

This program reduces and revises systems of linear equations into simplier systems and into a more useful system. For example, if one had a group of equations and would wish to solve for some of the variables in terms of other variables this system would overcome the tedious algebra that would be necessary. This is especially applicable in structures where a system would be replaced by its equivalent stiffness equations.

As an example of this, imagine a system such as:

D(A)	T(A)	M(A)	H(A)	D(B)	T(B)	M(B)	H(B)	= CONST.
X		X	X			X	X	X
	X	X	X			X	X	X
		X	X	X		X	X	
		X	X		X	X	X	X

The program can convert this into:

D(A)	T(A)	M(A)	H(A)	D(B)	T(B)	M(B)	H(B)	= CONST.
1				X	X	X	X	X
	1			X	X	X	X	X
		1		X	X	X	X	X
			1	X	X	X	X	X

By rearranging the variables, different quantities can be solved for.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7090 (4)

NUMBER OF CARDS: Approximately 60

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-2113

Linear Programming
(Chrysler)

Linear Programming is a method of optimizing a linear function subjected to a series of linear restrictions. This program consists of a group of restraints in the form of inequalities, and one equation which must be optimized. This program can minimize a problem containing as many as 25 restraints with up to 30 variables each. It gives cost or time as a result.

Timing: 75 seconds

This program is developed in the Simplex Procedure of Linear Programming.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7090 (4)

NUMBER OF CARDS: Approximately 100

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-2115

Heat Conduction in a Composite Solid with
a Receding Ablative Surface
(United Aircraft Corporation)

This program solves a one-dimensional heat conduction problem for a composite solid with a receding ablative surface. Heat inputs to the ablative surface may be specified as an arbitrary function of time, and ablative phenomena are based on an effective heat of ablation which varies with stagnation enthalpy.

All output is labeled and is self-explanatory.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7090 (4)

NUMBER OF CARDS: Approximately 600

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-2116

Resistance Thermometer Measurement Circuit Computer Program
(Boeing Company)

This program has been designed to calculate the Weatstone bridge resistance completion values for electrical bridges measuring temperature changes through resistance variations of a platinum resistance thermometer used as an active arm of the bridge circuit. The circuits designed with the aid of this program will be implemented on the S-1C on printed-circuit boards (or submodules) in the amplification module.

Calculated values for the output voltage of the bridge, both before and after amplification, and the current through the resistance thermometer are given. A tabular output showing the above values calculated at each print in the temperature range along with the corresponding resistance of the transducer is available from the program. Also computed are values for the amplifier gain factor, the resistance of high and low calibration resistors, and the average equivalent resistance of the circuit "looking-back" from the amplifer.

LANGUAGE: FORTRAN II, FAP

MACHINE REQUIREMENTS: IBM 7090 (4)

NUMBER OF CARDS: Approximately 2,300

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

MFS-2117

Transient Startup
(General Electric)

This program calculates the transient performance of a heat exchanger and connected piping. Inlet conditions are specified as a function of time. By replacing the heat exchanger system by a simple schematic that permits an essentially one-dimensional treatment of the problem, the exit conditions are calculated as a function of time by means of finite difference procedures. The necessary time increment is calculated by the program in order to insure stability of the solution. The inlet and outlet pipe walls can be assumed to be insulated or exposed to the ambient with up to 3 radiating sources.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 600

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

MFS-2119

Case Study Report
(Chrysler Corporation)

This is a generalized computer program that conducts statistical reliability analysis and tests for control on data submitted as case studies. Specifications defining a case are entered first; then, as data are submitted they are studied, analyzed and filed. New calculations are made each week and, if lack of control or an out of limits condition is indicated a report is issued to the sponsor of the case. Otherwise, the data are filed on magnetic tape. When issued, the reports are in the form of a regular X - Y plot with the scale horizontal across the top of the page and the time axis vertical along the left edge of the page.

Studies may be originated or discontinued at any time, and updating of each study is accomplished weekly by means of prepunched data collection cards that are supplied to the sponsor each week.

The run time is 100 cards per minute.

Description of the input:
The input is divided into two parts:
A. Input tape SYSCK1 new master (SYSCK2 from previous run).
B. Input cards.
With the exception of the first and last card, there are basically four groups of cards.
(1) Initialization cards to open a case.
(2) Data cards for a previously initialized case.
(3) Change cards for a previously initialized case.
(a) To change the case
(b) To change a date data point only
(4) Delete cards to delete a case completely

LANGUAGE: FORTRAN IV
MAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 860

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-2124

Complex Exponential Curve Fit

This program calculates a complex curve fit projected into the real domain given real numbers. It does this by using either the y-coordinates of the input curve, or by using the difference of the y-coordinates of the input curve. The x-coordinate used in the calculation starts at zero (o) and assumes one unit difference in the input points. The function can be translated into a new coordinate system after it has been obtained.

LANGUAGE: Fortran IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS REQUIRED: Approximately 2400

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-2125

Curve Fitting
(Marshall Space Flight Center)

There exists an abundance of numerical analysis procedures and techniques. To select the proper method for the case at hand sometimes becomes a problem. Most classical methods of numerical analysis are based on polynomial analysis. To know what polynomial should best fit a set of digital data is an admittance of considerable knowledge or prejudice about the data.

In working with test data, especially telemetry, where periodic cyclic functions are involved, the data is in many cases best described by circular functions. In this report a method is given to obtain a function which describes an arbitrary set of numerical data as a sine function. The function is completely determined and a complete numerical analysis is readily available. This method can be considered an approach to numerical analysis through the frequency domain, in contrast to the classical approach by polynomial analysis.

LANGUAGE: SPOOK

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 2700

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-2126

General N Dimensional Heat Transfer
(G. E. Huntsville)

This program is for the analysis of N dimensional heat transfer systems with arbitrary structure, boundary and initial conditions but with no more than 500 nodes and 1,500 node-to-node connections and with no more than 100 different time or temperature dependent functions for specific heat, resistance and/or heat flux. Any two nodes in the system may transfer heat to each other by some or all of the following nodes.

1. Conduction as function of time, temperature or pressure.
2. Convection as function of time or temperature.
3. Radiation.

If a trajectory is included in the input data then any or all nodes can have flat plate aerodynamic heating. The program can be used to find steady state conditions or it can write a history of a transient problem.

A fast sequential method is used which eliminates the need for searching through the resistors at each node in each time step or iteration.

Independent input cases may be stacked to save loading and setup time. Dependent cases may be stacked to save coding and input checking time as well.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 2,100

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

MFS-2127

Z-Plane NYQUIST Plot
(General Electric Huntsville)

This program finds the z-transform of ratios of polynomials in the Laplace variable. The resulting ratio of polynomials in Z is multiplied by a ratio of polynomials in Z specified by the user to form the completed z-transform. The z-transform Nyquist plot is computed by substituting $Z=e^{i2\pi fT}$ into the z-transform and scanning f between a starting and ending value while the phase change is held within certain specified limits.

It is a general program used for stability analysis in the frequency domain of linear, time invariant, sampled data systems. The above mentioned polynomials in the Laplace variable represent the continuous portion of the system while the z-transform represents the discrete portion. Translation of the entire system to z-transform representation and frequency response calculation is accomplished during execution of the program.

One polar log (Nyquist) plot is generated for each case with the log amplitude plotted versus the phase angle.

The program was verified by hand checking and by comparison of calculated results with test data.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094 and SC-4020

NUMBER OF CARDS: Approximately 6200*
*Includes plotting subroutine package

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

N O T I C E

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CORRECTIONS TO VOLUME I

PAGE NO.	PROGRAM NO.	AS SHOWN	CORRECT TO READ
10	COS 1892	First line: This program, coded in FORTRAN IV for the IBM 7094	First line: This program, coded in FORTRAN IV for the IBM 360
35	MFS 1127	Number of cards: Approximately 5,300* *Includes plotting subroutine package	Number of cards: Approximately 3800 Delete: *Includes plotting subroutine package
39	MFS 1487	Number of cards: Approximately 6,300* *Includes plotting subroutine package	Number of cards: Approximately 5,050 Delete: *Includes plotting subroutine package
111	MFS 1504	Number of cards: Approximately 6,600* *Includes plotting subroutine package	Number of cards: Approximately 5450 Delete: *Includes plotting subroutine package
107	MFS 12879	Documentation Fee: No Charge	Documentation Fee: $12.50
110	MFS 1137	In Section II; Insufficient documentation	In Section III; Missing subroutine

The following programs were published in Section III, missing subroutines. These are now fully operational and should be moved to Section I.

PAGE NO.	PROGRAM NO.	NUMBER OF CARDS
120	MFS 261	Approximately 5,100
121	MFS 388	Approximately 5,000
122	MFS 1129	Approximately 830
123	MFS 1133	Approximately 3,500
125	MFS 1496	Approximately 5,050 Delete: Includes plotting subroutine package
128	MFS 1509	Approximately 3,250 Delete: Includes plotting subroutine package
129	MFS 1517	Approximately 700
131	MFS 2083	Approximately 670

MFS-2128

Inverse Laplace Transformation of Partial Fraction
Extended Transfer
(G. E. Huntsville)

The object of this program is to find the original function under the Laplace Transform where the image function is a rational expression in which the numerator and denominator are both products of polynomials but where each factor polynomial has degree less than 3.

The results of this program were verified by hand calculation checks.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 800

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-2132

General Matrix Multiplication
(Chrysler)

The program accepts as input, from card or from tape, two matrices, (A) and (B), whose elements are either real or complex and performs a double-precision matrix multiplication. A provision has been incorporated to perform a special matrix re-arrangement. The re-arrangement is controlled by input option and consists of the following where the two matrices, (A) and (B), are of dimension 8 x 128 and 128 x 1 respectively.

$$\begin{matrix} A_{1,1} & A_{1,2} \cdots A_{1,128} \\ A_{2,1} & A_{2,2} \cdots A_{2,128} \\ \vdots & \vdots \quad \vdots \\ A_{8,1} & A_{8,2} \quad A_{8,128} \end{matrix} \qquad \begin{matrix} B_{1,1} \\ \vdots \\ B_{17,1} \\ \vdots \\ B_{33,1} \\ \vdots \\ B_{49,1} \\ \vdots \\ B_{65,1} \\ \vdots \\ B_{128,1} \end{matrix}$$

(continued on next page)

MFS-2132 (continued)

The 8 rows of (A) are multiplied by (B). (B) is then re-arranged to conform to the following:

$$
\begin{matrix}
B_{17,1} \\
B_{18,1} \\
\vdots \\
B_{128,1} \\
B_{1,1} \\
B_{2,1} \\
\vdots \\
B_{16,1}
\end{matrix}
$$

(A) is then multiplied by (B). This process on (B) is repeated 8 times to generate a resultant matrix, (C), of dimension 64 x 1.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 350

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-12875

Solution of Non-Linear Algebraic Equations Characteristic of Filter Circuits
(Northrop Space Lab)

This program is capable of solving simultaneous non-linear algebraic equations corresponding to a large number of sets of filter circuit equations. The unknowns in the equations are the values of resistances, inductances, and reciprocals of capacitances which occur in a filter circuit. Each equation consists of a sum of terms with each term consisting of the product of several unknowns and with the coefficient of each term equal to unity.

A previous attempt to program this problem needed refinement because the roots it obtained in solving the equations were generally not equal to off-the-shelf electrical components usually used in filter circuits. This current refined program has been successfully used to solve sets of equations in six unknowns and thirteen unknowns.

The output included the attenuation and phase shift vs frequency plots for the resulting filter circuit whose component values approximate a theoretical circuit.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 6,160*
*Includes plotting subroutine package.

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $10.00

MFS-12876

Neutrons-Cylinder Geometry
(General Electric)

Stochastic methods are needed to calculate the radiation transport and energy deposition of neutrons in cylinders with flat ends (liquid hydrogen medium). To estimate the number of particles per centimeter which escape the bounding surface, the cylinder is divided into 100 equal differential volumes. Each end is divided into ten concentric circles such that the area between any two circles is 1/10 of the total cross-sectional. The differential volumes are formed by the intersections of the concentric cylinders of radius Rj and the disks bounded by the planes, Zi.

The particles are traced through the cylinder in the following way: the contribution to the transmitted radiation of the uncollided particles is determined (both through the ends as well as the sides). Next the transmitted and reflected radiation after scattering is determined (both fore and aft ends and through the sides).

The program has the option of printing out (1) Neutron Heat Deposition and (2) Volume Distribution of Neutrons both as a function of the radius and depth into the cylinder.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 300

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

MFS-12878

Solutions of Systems of Non-Linear Equations
(Lockheed)

This is a composite computer program for solving an arbitrary system of simultaneous algebraic and transcendential equations. The term composite is employed to account for the fact that the program is a combination of techniques. These techniques are called the Newton-Raphson, Fletcher-Powell, Simplex and Contour Mapping. Such a program provides a spectrum of different approaches for seeking a solution and hence the capability for solving widely diverse classes of equations.

In applying this program to particular problems, it may quite often be useful to use one technique as an aid to another. For example, the Simplex Method could be used in some cases to determine a sufficiently close estimate of the root for either the Newton-Raphson or Fletcher-Powell Method. The contour mapping routine may be used to obtain useful information regarding approximate location of the roots, division between closely spaced roots, number of roots, ridges, valleys and saddle points. Such knowledge is often required in order to avoid convergence problems in applying any of the other three techniques.

In addition to solving systems of non-linear equations, another useful application of this program is in minimization (maximization) problems. The Fletcher-Powell, Simplex Method, and Contour Mapping Methods are basically minimization techniques.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 5950*
*Includes plotting subroutine package

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $10.00

MFS-12879

Computer Program for Determining the Thermal Environment and Temperature History of Lunar Orbiting Space Vehicles (Boeing)

This program has been developed to compute the thermal environment of a spacecraft in a lunar orbit. The quantities determined included the incident flux (solar, both direct and albedo, and lunar emitted radiation), total radiation absorbed by a surface, and the resulting surface temperature as a function of time and orbital position.

Since the thermal environment and surface temperatures of the spacecraft are a function of surface properties, obital parameters, vehicle configuration and orientation, the program has been designed to handle a variety of parameters with straightforward data preparation and a minimum knowledge of the program's workings.

LANGUAGE: FORTRAN II

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 1240

PROGRAM FEE: $75.00

DOCUMENTATION FEE: NO CHARGE

SECTION II

Programs Which Are Fully Operational, But With Documentation Which Is Not Complete In Certain Aspects

COS-1380

GAMMA-RAY-5 LAYERS
(General Electric)

This program uses stochastic methods to calculate radiation transport of gamma rays in plane slabs of infinite expanse but finite thickness. There can be up to five slabs of different shielding materials. The results include transmitted current, energy current, energy flux, buildup factors, transmission factors, angular distrubution of gamma rays and average transmitted energy.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 400

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-1135

Computer Code for Determining the Transient Behavior
of Optimum Inventories
(North American Aviation-Rocketdyne)

This is a FORTRAN IV digital computer program to find an optimum inventory size based on a time varying description of the behavior of the inventory level during the withdrawl and replenishing processes. This inventory control type of program is particularly applicable to damagable and repairable items. A cost function balances the loss due to unused items against the cost due to unfilled demands. Minimization of this total cost provides the criterion for optimization.

A model for an inventory of damagable and repairable items was formulated and its transient behavior was studied. In a given time interval the number of items that fail are assumed to be Poisson distributed. It was assumed that at the moment of failure a repair cycle is initiated and that the repair time is Erland distributed. In order to control this type of inventory a cost function that balances the loss due to unused items against the cost due to unfilled demands is employed. Minimization of this total cost provides the criterion for optimization.

The program also provides the first and second moments of the inventory as functions of time. The required input paramenters to the program are the failure or withdrawl rates, replenishing rate, cost factors, and the time interval over which the inventory is to be controlled. The program was written in FORTRAN IV and is limited to inventories of size 40.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7090 (4)

NUMBER OF CARDS: Approximately 250

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-1137

Measurement Systems Analysis Program
(North American Aviation-Rocketdyne)

This program consists of the following:

1. A series of process specifications which prescribe calibration and maintenance techniques for the following measurement systems:

    1. Thrust (force)
    2. Pressure
    3. Temperature
    4. Flow Rate
    5. Vibration
    6. Current and Voltage

The specifications also outline statistical techniques for evaluating system performance from calibration data.

2. A set of computer programs for processing rapidly, measurement system calibration data. The outputs of these programs indicate quantitative measures of instrument performance. Corrective action is recommended when necessary.

3. A procedure for distributing to some fifty test facilities a program output listing, or "roadmap". Each listing is a comprehensive report of the status of the some forty measuring systems at each respective test stand.

The MSA program combines automated "inventory-type" control with modern statistical techniques to provide easily assessable information attesting to the status of thousands of measuring systems.

LANGUAGE: FORTRAN II, FAP

MACHINE REQUIREMENTS: IBM 7090 (4)

NUMBER OF CARDS: Approximately 1695

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-1504

MIDAS
(North American Aviation-Rocketdyne)

Midas is a digital computer program that compiles analog computer block diagram to solve the problem on the digital computer. The program was modified to FORTRAN IV, streamlined, and several options were added by the innovator.

The program now functions in the following manner. Analog computer elements are listed with their inputs in a fairly rigid computer input format. The first phase of program operation is to convert the listing to an operation table and to furnish an object deck of this table for further usage, similar to the compilation of a Fortran program. The program then enters the execution phase, in which derivatives of all integrators are evaluated over various time intervals until the system error meets the specified criterion. The integration scheme used is the predictor-corrector method with variable interval. The latter allows the computer to adjust for periods of solution when little is happening. CRT and printout at specified time intervals as well as maxima and minima of all simulated elements is available as program output. The available elements include variable delays, an implicit element for algebraic iteration, and a special element, which is a Fortran subroutine to accomplish a specific task in the program. A debugging scheme is available to print diagnostics for various program errors.

LANGUAGE: FORTRAN IV, MAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 6,600*
*Includes Plotting Subroutine Package

PROGRAM FEE: $75.00

DOCUMENTATION FEE: No Charge

MFS-2085

Variable-Boundry Transient Heat Conduction Program
(Chrysler)

This program contains various trajectory, aerodynamic heating and compressible fluid flow options. It is basically a general heat transfer program but utilizes an implicit forward-backward method of finite differencing with a self contained predictor-corrector routine.

LANGUAGE: FORTRAN II, FAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 3500

PROGRAM FEE: $75.00

DOCUMENTATION FEE: No Charge

MFS-2090

Staging Analysis Procedure
(Boeing)

The procedure determines the interplanetary vehicle configuration that can be built up from single fixed stage element size for a particular interplanetary mission.

The procedure has been programed and is presently being used in conjunction with the Interplanetary Conic Program to investigate best stage size for a nuclear powered vehicle.

The scheme is directly applicable to trajectories that include flybys, swingbys, midcourse maneuvers and plane changes in addition to the current stopover trajectories.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 340

PROGRAM FEE: $75.00

DOCUMENTATION FEE: No Charge

MFS-2129

Heat Exchanger Program
(Boeing)

The heat exchanger program is capable of calculating the steady state performance of heat exchangers. The tubes are divided into a number of short increments in order to evaluate the fluid properties at local conditions.

The primary results of this program are the fluid temperatures and pressure printed at specified intervals along the exchange tube length.

Options within the program make it possible to directly analyze test data. Also, any correlation desired by the user can be used to make the heat transfer calculations.

LANGUAGE: FORTRAN II, FAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 650

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-12871

Neutron-Hydrogen Slab
(General Electric)

This program uses stochastic methods to calculate the radiation transport and energy deposition of neutrons in liquid hydrogen plane slabs of infinite expanse but finite thickness. The results include heat rate deposition as a function of depth, Albedo factors and slow neutron spatial distribution.

The program is restricted by dimension statements on program variables. The random number generator must be initialized (usually with "1") for the first case. For succeeding cases it may be re-initialized or proceed from the previous case. The random number generator yields a rectangular distribution of numbers between zero and 1. Output includes input information, tables of printouts. Current flux, energy current, energy flux, and dose rate vs. source, uncollected component, scattered, sigma, build-up factor, transmitted and reflected. Next is a table of energy deposition by layers followed by a table of volume distribution of thermalized neutrons by layers. Input is printed again on a second page followed by a table of scattered transmission with energy vs. cos θ.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 300

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-12872

Gamma Ray-Cylinder Geometry
(General Electric)

This program uses stochastic methods to calculate radiation transport and energy deposition of gamma rays in right circular cylinders with flat ends (liquid hydrogen medium). The results include heat rate deposition as a function of depth and transmitted angular distribution of gamma rays.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 380

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-12873

GAMMA-RAY - 9 Layers
(General Electric)

This program uses stochactic methods to calculate radiation transport of gamma rays in plane slabs of infinite expanse but finite thickness. There can be up to nine slabs of different shielding materials. The results include transmitted current, energy current, energy flux, buildup factors, transmission factors, angular distribution of gamma rays and average transmitted energy.

LANGUAGE: FORTRAN IV, MAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 600

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-12874

Gamma Rays-Hydrogen Slab
(General Electric)

This program uses stochastic methods to calculate radiation transport and energy deposition of gamma rays in liquid hydrogen plane slabs of infinite expanse but finite thickness. The results include heat rate deposition as a function of depth, albedo factors and transmitted angular distribution of gamma rays.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 360

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

SECTION III

Programs with documentation, but are missing one or more subroutines. The requestor may obtain these programs, with the option of receiving any missing subroutine when it becomes available. It will be the responsibility of the requestor to advise COSMIC whether or not he has need for the missing subroutine.

NUC-10051

ISUDS-Iterative Scheme Using a Direct Solution
(Westinghouse)

When solving a system of simultaneous equations, on a computer, the accuracy of the solution decreases as the order of the system increases. ISUDS finds a solution to the system of equations and increases the accuracy of the solution by a direct method of computation. Using this method double precision accuracy is obtained while using a single precision coefficient matrix.

The equations are written in matrix form as AX=B, where A is a square, non-singular matrix, S is a vector and B is a vector. A solution for X is obtained and substituted in the system. The right-hand members of a new set of equations are the residuals obtained from the first solution. Using the residuals as right-hand members the system of equations are solved again.

The first solution (X), satisfies the equations with right-hand members equal to vector B minus the residuals R. The second solution (X_2) satisfies the same system with the residuals as right-hand members. Thus $X_1 + X_2$ satisfies the same set of equations and $(B - R) + R = B$ the sum of $X_1 + Y_2$ will give an accurate solution to $AX = B$.

The method presented is a one step improvement procedure; however, by redefining X_1 as $X_1 + X_2$ (the improved solution) any desired accuracy could be obtained. The highest order problem solved by the program is 170.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 100

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-261

"Shore-Catch" A Heat Transfer Digital Computer Program
(Lockheed)

This computer program calculates the aerodynamic heating rates to blunted-and-pointed-nose vehicles during the exit phase of the trajectory, using real gas properties for air in the solution. The program is capable of calculating an inviscid supersonic flow field over bodies-of-revolution at zero degrees angle-of-attack. This flow field calculation is performed by using a combination of the Belotserkovskii blunt body solution and the Syvertson and Dennis Second-Order Shock-Expansion Method. To generalize the program, the capability of reading in this flow field has been included. Eleven aerodynamic heating methods have been programmed, and storage locations have been allocated for additional methods. Because of the restricted application of many of the heat transfer prediction methods, the selection of which method(s) to use has been left to the user of the program.

Input data is composed of concise problem definitions, viz: the geometry of the shell, material properties, trajectory data, and a small number of numerical solution parameters. Non-linear effects (e.g. temperature-dependent material properties, radiation boundary conditions) are allowed. Through a small number of input variables, users of the program control the character of the nodal network, but the task of computing network details (i.e. the number of nodes, individual nodal dimensions, topology, etc.) is performed by the program.

Included is a description of the methods programmed, how the program functions and a detailed description of the input and the output. A sample problem with associated input and output is presented in an Appendix.

LANGUAGE: FORTRAN IV, MAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 5,000

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $10.00

MFS-388

"Shore-Catch" A Heat Transfer Digital Computer Program
(Lockheed)

This computer program calculates the aerodynamic heating rates to blunted-and-pointed-nose vehicles during the exit phase of the trajectory, using real gas properties for air in the solution. The program is capable of calculating an inviscid supersonic flow field over bodies-of-revolution at zero degrees angle-of-attack. This flow field calculation is performed by using a combination of the Belotserkovskii blunt body solution and the Syvertson and Dennis Second-Order Shock-Expansion Method. To generalize the program, the capability of reading in this flow field has been included. Eleven aerodynamic heating methods have been programmed, and storage locations have been allocated for additional methods. Because of the restricted application of many of the heat transfer prediction methods, the selection of which method(s) to use has been left to the user of the program.

Input data is composed of concise problem definitions, viz: the geometry of the shell, material properties, trajectory data, and a small number of numerical solution parameters. Non-linear effects (e.g. temperature-dependent material properties, radiation boundary conditions) are allowed. Through a small number of input variables, users of the program control the character of the nodal network, but the task of computing network details (i.e. the number of nodes, individual nodal dimensions, topology, etc.) is performed by the program.

Included is a description of the methods programmed, how the program functions and a detailed descriptions of the input and the output. A sample problem with associated input and output is presented in an Appendix.

LANGUAGE: FORTRAN IV, MAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 5,000

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $10.00

MFS-1129

Optimization Program
(North American Aviation-Rocketdyne)

This is a general purpose program to find the values of 40 or less independent variables that minimize a dependent variable to establish an optimum. The feature of the program is a minimum seeking scheme concept. It has application for problems requiring optimum values in order to use the minimum volume of gases or liquids to maintain set conditions of temperature or pressure.

The program uses a search scheme which hunts for the minimum by taking a new value for an independent variable and examining it for either a new minimum or being past the minimum. A simple optimum, a local simple minimum of something very close to it is assumed. Every 3 steps the progress is accelerated by the regula falsi method. If this happens to catch the search on a reverse slope, the acceleration is discarded. If more than four steps are taken without passing a minimum the increment is doubled every step. This is usually applied only at the beginning of the process. If the first step is false, it immediately reverses direction. Each time the minimum is passed, the search increment is cut to a fraction of its former value, and the direction reversed. The independent variables are optimized in turn, until the last one is done, and then the process starts again with the first. This cycle is repeated five times. (Final values are punched out for later input if a continuation is desired.) Output is the value of all variables for each try.

The program needs a subroutine SIMP which the user supplies. The subroutine should calculate the value of the dependent variable. Data is read in by a format which makes each card self contained. Each card contains the following information: number of pieces of data on card, location of first piece of data on card in the input array (each following piece of data on the card is stored in successively higher locations in the input array), and up to five peices of data.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 830

PROGRAM FEE: $75.00

DOCUMANTATION FEE: No Charge

MFS-1133

Cross-Spectral Analysis
(North American Aviation-Rocketdyne)

The cross-spectral analysis program takes as input two stationary time series from simultaneoulsy measured sample records. Multiple cases are treated sequentially, and the time series as well as all the other input data may differ in any respect from one analysis to another. For data input purposes, the X (input time series of the linear model) and Y (observed output) time series sample records are handled in an independent manner. Initially, the two sample records need not consist of the same number of points, nor to have been sampled at the same rate. When this is the case, the program will reduce the effective sampling rate of the data prior to the cross-spectral analysis as indicated by one of the control variables. After any desired sampling rate reduction has been accomplished, for either time series, the resulting sample records are calibrated by the application of multiplicative calibration factors and trends are derived from the resultant sample records. The program, then computes estimates of the autocovariance and the cross-covariance functions and then obtains smoothed estimates of the power spectral densities, cospectral density, and quadrature spectral density. From these, estimates of the coherence and frequency response functions are derived.

In addition to trend removal and arbitrary prescaling of time series, the program provides other auxillary features such as tests of significance of convex power peaks, corrections for frequency response characteristics of the measurement system, and corrections for filters employed in the generation of the time series input. A variety of modes of data input and output are abailable on a user option basis, including CRT plots of the various functions estimated.

LANGUAGE: FORTRAN IV, MAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 2800

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

MFS-1134

Multi-Dimensional Spectral Analysis Computer Program
(North American Aviation-Rocketdyne)

This program performs statistical multiple spectral analysis of up to seven time series from simultaneously measured sample records. For stationary time series the program computes estimates of all auto-covariance and cross-covariance functions and then obtains smoothed estimates of all power spectral densities, cospectral densities, and quadrature spectral densities associated with the time series. From these coherence and frequency responses and multiple coherence functions are derived. For non-stationary time series, time-varying estimates are derived.

LANGUAGE: FORTRAN IV, MAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: 7,100*
*Includes plotting subroutine package

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-1496

Simulation Program of the Design, Test, and Analysis Phases of Numerous Types of Sensitivity Experiments
(North American Aviation-Rocketdyne)

This is a FORTRAN II, general purpose program for the simulation of the design, test, and analysis phases of numerous types of sensitivity experiments. A modular concept is used in coding the program with routines of design, response function analysis, or utility subroutines. Three subroutines are essentially "buffers" to call the specific routine required for implementation. Two utility routines handle program output.

General purpose application can be made for simulation of the design, test, and analysis phases of sensitivity experiments using response functions.

LANGUAGE: FORTRAN IV, MAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 7600*
* Includes plotting subroutine package

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-1501

High Speed Root Locus Plotting Program
(North American Aviation-Rocketdyne)

This digital program, separable into a subroutine usable with other digital programs, and a main program, was written in FORTRAN IV utilizing lower accuracy, but much higher speed. In addition, provision was included for plotting up to five root loci on one graph for making parameter variation studies. Several gain programs are available to the user. Output is both by CRT plot and printed. Input is the ratio of two polynominals in S, either factored or unfactored. Angles and CG of the asmyptotes are printed. Accuracy is maintained to four decimal places. On encountering nonconvergent roots, the user is offered three alternatives: skipping the root; plotting the nonconvergent root; or resubmitting the offending polynominal to slower, more accurate, polynominal factoring subroutines.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 5600*
*Includes plotting subroutine package

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-1505

Bearing Analysis Program With a Plotting Subroutine
(North American Aviation-Rocketdyne)

This is a FORTRAN IV program to provide an analysis of a system of bearings operating at a given speed under a known system load. A subroutine was written to store all necessary data from a number of calculations and then plot it on an SC4020, 9-inch by 9-inch frame. Input to the program is a complete description of a bearing system. The output is in both graphical and printed forms. System restrictions are number of bearings ≤ 6 and number of rolling elements per bearing ≤ 40. Output restrictions for graphical data are a maximum of three bearings, presented only for thrust or inner race revolutions per minute as an independent variable. The average execution time is 30 seconds per case.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 5600*
* Includes plotting subroutine package

PROGRAM FEE: $75.00

DOCUMENTATION FEE: NO CHARGE

MFS-1509

Digital Computer Routines For Analysis of Control Systems and Components
(North American Aviation-Rocketdyne)

This is a library of digital computer routines and subroutines in FORTRAN II for repeated use in programming mathematical models of control systems and components. Iterative solutions of time dependent dynamic response are obtained. The main program is for control of the subprograms, data storage, printout, and CRT displays. Eight subroutines compute flowrates, pressure, acceleration, velocity, displacement forces (spring deflection), and CRT displays of selected output data. If one or more subprograms or main programs requires computation of gas weight flowrates, the same subroutine is called for in all flow computations. Similarly, other subroutines can be used repetitively.

LANGUAGE: FORTRAN II

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 3,200*
*Includes plotting subroutine package

PROGRAM FEE: $75.00

DOCUMENTATION FEE: No Charge

MFS-1517

Maximum Likelihood Estimates of Cumulative Normal Response Functions Program
(North American Aviation-Rocketdyne)

This is a FORTRAN II program to calculate the maximum likelihood estimates of cumulative normal response functions. An iterative (Newton-Ralphson) procedure is used. "Good first guesses" are considered of prime importance to insure convergence and reasonable calculation time. The estimates are calculated to the desired accuracy and verified that the solution is at a maximum of the likelihood function. The covariance matrix of the maximum likelihood estimates may be estimated by the usual asymptotic theory.

LANGUAGE: FORTRAN II

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 600

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-1647

Research and Development Project Planning and Flow Control System (North American Aviation-Rocketdyne)

The introduction of Configuration Management rules and regulations together with incentive rating and cost for the aerospace research and development contracts, created the need to evaluate the present R&D and D&D management and control systems. The principal objective is to generate engineering drawings according to schedules to insure properly timed flow in support of committed delivery dates.

The system's format and documentation methods are valuable management tools in defining and projecting the program's feasibility, budgeting requirements, manpower load, etc.

LANGUAGE: FORTRAN IV, MAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 4,850*
*Includes plotting subroutine package

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MFS-2083

Smoothing and Differentiation Routine
(Chrysler)

The program takes a binary tape of a particular format and, using the method of least squares, computes a set of smoothing coefficients for a given number of points at a given interval, smooths the set of positions on the input tape, computes velocities, accelerations, and standard deviations for positions, velocities and accelerations and writes this information on a binary tape and a print tape.

LANGUAGE: FORTRAN IV, MAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 670

PROGRAM FEE: $75.00

DOCUMENTATION FEE: NO CHARGE

MFS-2092

Frequency Response Routine Which Handles The Effect Of Time Delays (North American Aviation-Rocketdyne)

This idea incorporates a FORTRAN IV program to tabulate values of gain in decibels and phase angle vs frequency and plots of gain, and phase vs the log of the frequency for specified variables with respect to the input variable. Derivitives of variables of the "n" order and the input are permitted with the inclusion of a time delay in the input perturbation.

There is a possible automotive or industrial application of turbine dynamic system studies of frequency response and related effects of time delays.

LANGUAGE: FORTRAN IV, MAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 5,600*
*Includes plotting subroutine package

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

MFS-12870

VITRAN-Vibration Transient Analysis Program
(Lockheed)

Previous analysis of transients in vibration data from launch vehicles was performed by either visual analysis of oscillograms or analog filtering. Both methods were undesirable with respect to accuracy, time, and manpower requirements. VITRAN was developed by Lockheed Missiles and Space Company, Sunnyvale, California as a digital method of shock spectrum analysis using recursive filtering.

One hundred and seventy-five (175) digital filters are used for each analysis. The frequencies are incremental by 5 cps from 30 to 200 cps, by 10 cps from 200 to 1000 cps by 20 cps from 1000 to 2000 cps and by 50 cps from 2000 to 2500 cps. The VITRAN program contains an option of specifying values for basic percentages and cps bandwidth.

The vibration records are recorded on analog tapes. This data is used as input to the analog-to-digital converter and the CAL-RMS digital program. The output of the CAL-RMS program is used as input to the VITRAN program. The output of the VITRAN program is a series of SC-4020 plots of the transients, the transient analyses and (optional) as many as six filter outputs.

LANGUAGE: FORTRAN IV, MAP

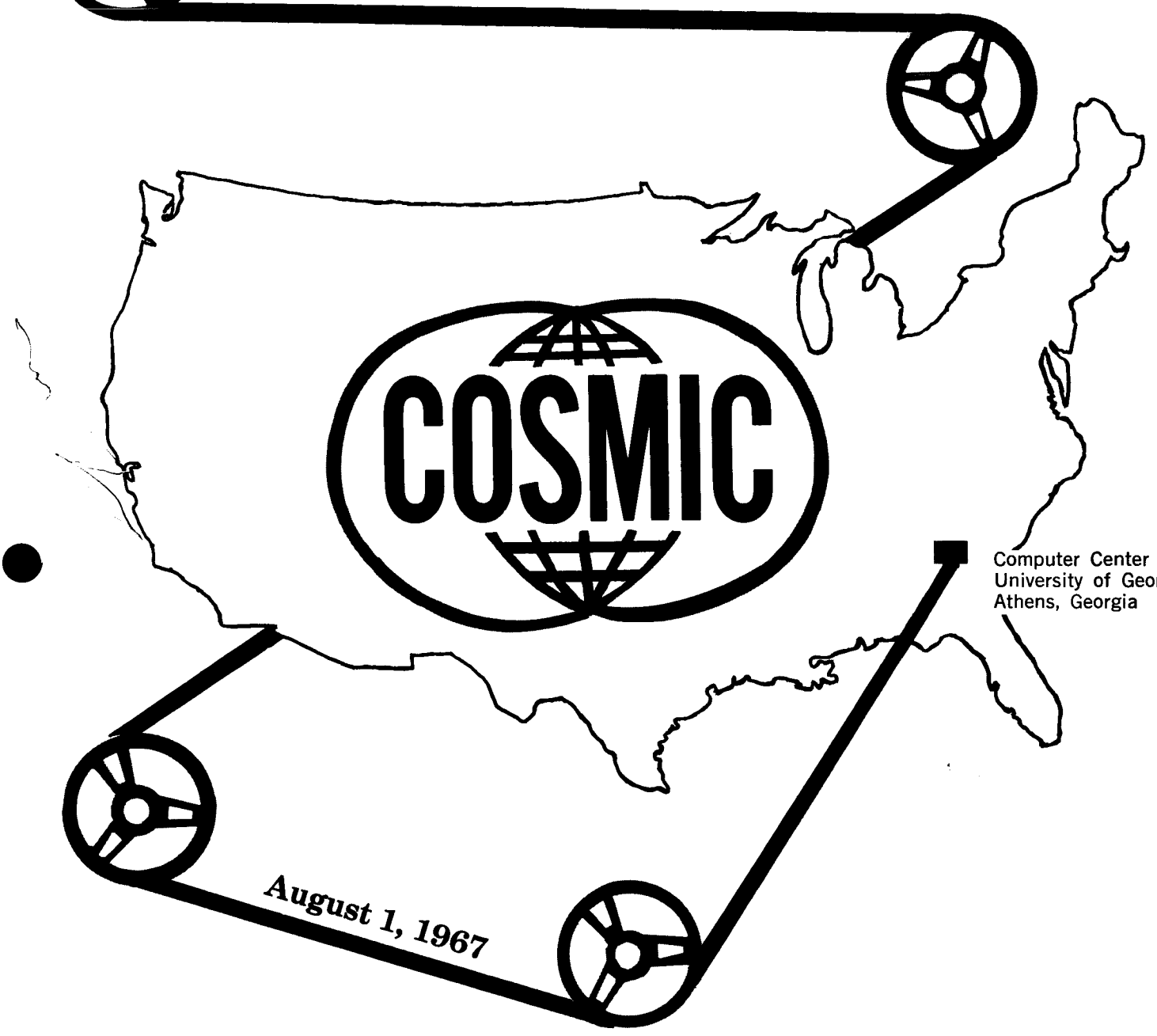
MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 5200*
*Includes plotting subroutine package

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

A Directory of Computer Programs Available from COSMIC



Computer Center
University of Georgia
Athens, Georgia

August 1, 1967

SUPPLEMENT 1 TO VOLUME 1

KWIC INDEX

TABLE OF CONTENTS

These Programs Are Fully Operational And
Have Sufficient Documentation To Run

COS-710

Velocities and Streamlines for Two-Dimensional Incompressible Flow in Axial Blade Rows (Lewis Research Center)

This program was written to give the solution of the two-dimensional, incompressible, ideal flow problem for an infinite cascade of blades, or equivalently, a two-dimensional, circular cascade of constant radius, as in an axial-flow turbine. The computer program requires only the basic cascade geometry as input. The output includes streamline coordinates, velocity magnitude and direction throughout the passage, and the blade surface velocities. The method is based on the stream function, with the solution of the simultaneous, linear finite-difference equations being obtained iteratively by using successive overrelaxation, with an estimated optimum overrelaxation factor. The program can be used in the design of blade rows for turbines or compressors.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 1,600

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $5.00

Automatic Flow Charting Program, FLOW2
(U.S. Naval Ordnance Test Station)

FLOW2 is a program that produces flow charts from the source decks of FORTRAN II, FORTRAN IV, or FORMAC programs or from special input decks. The principal output of the program is a magnetic tape intended for use as input to a General Dynamics SC-4020 plotter. The program can also produce punched-card output containing all the essential information required to reproduce the flow chart in a form that can easily be modified by the user; this modified deck may then be used as input to the program to produce a flow chart more suitable to the user's needs.

Any combination of the following may be included among the decks to be processed:

1. Any FORTRAN IV main program, subroutine, or block data subroutine. The END card must be present; however, the $IBFTC card is not required.

2. Any FORTRAN II main program or subroutine for any of the following machines: 1620/1710, 1401, 704, 705, 7040/44, 709, 7090/94, 650. The END card must be present.

3. Any FORMAC subroutine. The subroutine must begin with a $IBFMC card and must terminate with an END card.

4. Any FLOW deck. This is the output deck from the flow chart program which is described below. Such a deck must begin with a $FLOW card and end with a $NDFLO card.

5. Any MAP deck beginning with a $IBMAP card and ending with an END card.

6. Any FAP deck <u>except</u> a FAP update with assembly deleted. This deck must be preceded by an * FAP card and must be followed by an END card.

(continued on next page)

7. Any COBOL deck which is preceded by a $IBCBC card and followed by a $CBEND card.

8. Any column binary deck from any of the above source decks.

9. Any IBJOB debug package. A load time debug package must begin with a $IBDBL card and end with an *DEND card. A compile time debug package must begin with a $IBDBC card and must be followed by any card with a $ punched in column 1.

10. Any monitor control card ($ or * in column 1) not listed above. These cards may occur anywhere between decks; they may not be placed within decks of types 1 through 4.

LANGUAGE: MAP

MACHINE REQUIREMENTS: IBM 7090/94,
SC 4020 plotter

NUMBER OF CARDS: Approximately 10,100

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $5.00

SIFT: Semiconductor Information Filing Technique
(Booz-Allen)

SIFT (Semiconductor Information Filing Technique) is a computer executed information storage and retrieval system which permits selective retrieval of information on diodes and transistors manufactured in the U.S.

The system makes no attempt to judge the stored data; system design has been focused on providing the facts and suitable reference aids for human selection. When suitable retrieval requests are made of the file, the system will select and present to the user a listing of part numbered devices that fulfills his requirements. The system can thus be used to supply a complete listing of technical component information necessary for circuit designers, reliability engineers, and quality assurance personnel.

Any of the following types of information can be searched:

1. Device number
2. Maximum electrical characteristics
3. Typical electrical characteristics
4. Minimum electrical characteristics
5. Manufacturer(s)
6. Specifications to which each device can be procured
7. Numbers of reports describing pertinent reliability, test data, and failure information
8. Applicable comments

SIFT consists of 12 files stored on magnetic tape and 36 computer programs for conducting a variety of searches and for updating the files. The 12 individual files are:

1. General transistor file
2. Switching transistor file
3. Silicon controlled rectifier file
4. Unijunction transistor file
5. Field effect transistor file
6. General diode file
7. Reference diode file
8. Video detector file
9. RF mixer diode file
10. Switching diode file
11. Tunnel diode file
12. Variable capacitor file

(continued on next page)

The system is designed to run on a CDC 160-A computer with the following peripheral equipment:

2 tape transports
1 punched paper tape reader
1 card reader
1 line printer

The programs were originally written in AUTOCOMM. However, only the systems tape (librarian) is available at the present time.

LANGUAGE: (see explanation above)

MACHINE REQUIREMENTS: CDC 160-A (see above for complete system required)

NUMBER OF CARDS: Available only on tape

PROGRAM FEE: $500 (see note below)

DOCUMENTATION FEE: $10.00

NOTE: The fee of $500 for this program is due to the special handling required by the 13 reels of tape containing the programs and the data.

Equilibrium Normal Shock and Stagnation
Point Solutions for Arbitrary Gas Mixtures
(Langley Research Center)

This program computes solutions for flow parameters in arbitrary gas mixtures in the following situations; (1) behind normal shock, (2) behind a reflected normal shock, (3) for inflight stagnation conditions, and (4) for shock tube stagnation conditions.

Equilibrium thermodynamic and chemical calculations are carried out utilizing a free-energy minimization technique coupled with the conservation equations and a modified Newton-Raphson iterative scheme. Chemistry up to second ionization is included.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 1,650

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $5.00

Improved Analytic Longitudinal Response Analysis for Axisymmetric Launch Vehicles (Langley Research Center)

This program uses an improved linear analytical model for the calculation of launch vehicle steady-state response to applied sinusoidal loads acting in the longitudinal direction. The present approach utilizes a finite element technique to construct the total launch vehicle stiffness and mass characteristics by subdividing the prototype structure into a consistent set of:

(1) axisymmetric shell components to represent as separate units the fairing, interstage structure, bulkhead, tank walls, and engine thrust structure

(2) fluid components

(3) mass-spring components to provide the inertial and stiffness characteristics of the equipment and engines and vehicle supporting structure

The total vehicle characteristics are obtained by superposition of the stiffness and inertial characteristics of the individual shell, fluid and mass-spring components which are computed using a generalized coordinate approach. Fluid force and inertial coupling between all structural components is accomplished by assuming fluid motions consistent with the shell component distortions. The superposition technique automatically assures displacement compatibility and satisfies force equilibrium at the joints between components. After the complete system matrix has been formulated, displacement boundary conditions are introduced by removing appropriate rows and columns of matrix coefficients corresponding to points on the vehicle and its supports which are rigidly restrained from motion.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 4,700

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $12.50

D0554 One-Dimensional Analysis of Thermal Protection Systems
(Langley Research Center)

An adequate thermal protection system may constitute 20 to 30 percent of the total re-entry weight for vehicles which must enter the earth's atmosphere at supercircular velocity. Differential equations governing the transient response of thermal protection systems to a hyperthermal environment are presented in this document. These equations are expanded into finite-difference equations which are suitable for numeric solutions. The equations provide for three layers of different materials; the first two of which may have moving boundaries. Concentrated heat sinks, such as metallic structures, may be located at the back surface of the second or third layers or of both layers.

The analysis was developed primarily for charring ablators but is also applicable to impregnated ceramic, subliming, and heat-sink thermal protection systems. The principle difficulty encountered in numerical analysis of charring ablators is the extensive computer time required to obtain solutions. However, options are available to reduce the time, and good agreement is obtained between numerical results and exact solutions. See Flash Sheet LAR-10095 for implicit solutions.

LANGUAGE: FORTRAN IV,
MAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 3,650

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $5.00

D2380 One-Dimensional Analysis of Thermal Protection Systems
(Langley Research Center)

An adequate thermal protection system may constitute 20 to 30 percent of the total re-entry weight for vehicles which must enter the earth's atmosphere at supercircular velocity. Differential equations governing the transient response of thermal protection systems to a hyperthermal environment are presented in this document. These equations are expanded into finite-difference equations which are suitable for numeric solutions. The equations provide for three layers of different materials, the first two of which may have moving boundaries. Concentrated heat sinks, such as metallic structures, may be located at the back surface of the second or third layers or of both layers.

The analysis was developed primarily for charring ablators but is also applicable to impregnated ceramic, subliming, and heat-sink thermal protection systems. The principle difficulty encountered in numerical analysis of charring ablators is the extensive computer time required to obtain solutions. However, options are available to reduce the time and good agreement is obtained between numerical results and exact solutions. See Flash Sheet LAR-10094 for explicit solutions.

LANGUAGE: FORTRAN IV,
MAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 2,900

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $5.00

LAR-10117

Free-Jet Investigation-Characteristic Method
(Langley Research Center)

This program computes the characteristics of a jet boundary using three-dimensional irrotational equations of flow. A set of initial conditions on the leading characteristic and the conditions for a series of two-dimensional expansion rays originating at the nozzle lip are given. If a pair of the same family lines cross, the points involved drop out, and the point where the crossing occurred is used in subsequent calculations.

The characteristic method presented for computing highly underexpanded free-jet boundary contours permits extension of the calculations to very high pressure ratios and large distances downstream from the nozzle exit. The document presents programs for the leading characteristic line, corner expansion fan, and the characteristic network.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 1,150

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $10.00

LEW-0240

Analytical Comparison of Ablative Nozzle Materials
(Lewis Research Center)

This program is designed to analytically predict the ablation performance of rocket nozzle heat protection materials. The program is based on the use of nonsymmetrical difference equations that are employed to solve systems of complex partial differential equations.

The program can be used to predict the thermal degradation of a wide variety of materials exposed to an external source of heat. It can be generally adapted to the simulation of processes involving heat and mass transfer by substituting specific parameters into the basic equations. In the kiln drying of lumber, for example, profiles of temperature, humidity, and drying time for woods of different types can be simulated to predict minimum process cost and loss of material. The program could also be adapted to the simulation of the manufacture of ceramics, the casting of large concrete structures, and the propagation of forest fires (to determine optimum methods of control).

The program also includes the effects of mass addition on heat transfer, the calculation of internal gas pressure and internal material stresses, and a number of other options for surface or char removal.

The program has previously been used to compare performance of phenolic nylon, phenolic graphite, and phenolic refrasil as rocket nozzle heat protection materials.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 7,450

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $15.00

Mass Property Error Analysis
(North American Aviation-Rocketdyne)

This program is used to obtain accurate estimates of variance for the weight center of gravity and moments of inertia of a vehicle or engine. Prior methods used were performed by hand computation. This program application has resulted in more accurate estimate of variance and expanded data output, with considerable reduction in computation time.

The program computes the mass properties and the variances of the vehicle or engine from data defining the mass properties and variances of individual components comprising the total vehicle or engine. Input data consists of: total weight, total weight variance; center of gravity, center of gravity variance; moment of inertia, moment of inertia variance; product of inertia, and product of inertia variance. This input data is obtained from actual measurements or from analysis. The data is combined via a statistical theory which allows the program to also compute the principal axis orientations.

This program can be applied generally to any mass property such as a vehicle, engine, or a component part, where it is necessary to determine accurate estimates of variance for the weight, center of gravity, and moment of inertia.

LANGUAGE: FORTRAN H

MACHINE REQUIREMENTS: IBM 360

NUMBER OF CARDS: Approximately 1,250

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

General Frequency Response Program
(The Boeing Company)

In recent years, perhaps due to early successes in military applications, the analysis of automatic control systems has become an important problem in many diverse disciplines. A central question is that of stability: Do the dependent variables describing a dynamic system remain bounded under the perturbations arising from the physical environment? Because of its ease of application, the frequency response method is a natural tool for stability investigations. This document describes a computer program to provide the frequency response of any linear feedback control system.

The General Frequency Response Program enables computation of the open loop frequency response of a closed loop control system. The system characteristic matrix, obtained from the Laplace transformations of the dynamic and control equations, is input to the program. A variety of outputs are available, including a detailed print, a summary print, and Nyquist and Bods plots. Other program features of interest are the following: variable frequency increment, multiple frequency ranges, parameter variation, amplitude to decibel conversion, and linear interpolation of amplitudes and phases at critical points.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7044/7094

NUMBER OF CARDS: Approximately 1100

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $5.00

Film Coefficient and Recovery Temperature For a Flat Plate in Continuum, Slip, and Free Molecule Flow (Boeing)

The slip and free molecular equations developed by Truitt and the continuum equations developed by Almond, Jackson, and von Tuchs are used to develop a computer program to determine the heat transfer film coefficient and recovery temperature for a flat plate in continuum, slip, and free molecule flow. The analysis for slip flow is based upon a solution to the Navier-Stoker equations with a slip velocity imposed at the surface. The validity of these equations is somewhat questionable (from lack of experimental verification) but are used since they are representative of the current state-of-the-art.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 800

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $5.00

Principle Axis Computation
(North American Aviation-Rocketdyne)

This is a program to compute accurate values of principal axis directions and moments of inertia about these axes for any component or group of components the mass properties of which are known with respect to some other reference coordinate system. Six parameters are required as input; three values for moments of inertia and three for the products of inertia. These inputs are taken about a reference system of cartesian coordinates originating at the center of gravity of the total mass under consideration. Input parameters are printed with the output. The only restriction is that all inputs must be expressed in identical units.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 208

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

Axial Velocity of an Incompressible Fluid Flowing in Radial Equilibrium-Case No. 1 (North American Aviation-Rocketdyne)

This program calculates the axial velocity of an incompressible fluid flowing in radial equilibrium. Euler's equations of motion are applied in the solution. All velocities from hub to tip between blade rows must be known in order to determine the blade profiles. A numerical solution is used to solve for continuity, except in a case of constant velocity. The values of blockage factor, density, etc. are used as inputs with two guesses as to axial velocity at the tip. The program uses these values to interpolate, first linearly and then with progressively higher order curve fits until continuity is satisfied. Accuracy of the guesses is not important; however, the more accurate guess will reduce running time.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 121

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

Iterative Linear Approximation for Equation Solving with Initial Estimate (SEARCH)
(North American Aviation-S & ID)

Let $F(X) = Y$ be any function and Y_{GOAL} be some desired point. From a user supplied initial value, X, SEARCH finds two values of the independent variable, X_L and X_H, such that $F(X_L) < Y_{GOAL} < F(X_H)$. The program then iterates by linear interpolation

$$X_{NEW} = X_L + \left(\frac{Y_{GOAL} - F(X_L)}{F(X_H) - F(X_L)}\right) (X_H - X_L)$$

If $\left| F(X_{NEW}) - Y_{GOAL} \right| > \varepsilon$, ε user supplied, the program reiterates, keeping the point bracketed, until $\left| F(X_{NEW}) - Y_{GOAL} \right| \leq \varepsilon$.

LANGUAGE: FORTRAN II

MACHINE REQUIREMENTS: IBM 7090/94

NUMBER OF CARDS: Approximately 50

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

Iterative Linear Approximation for Equation Solving
Without Initial Estimate (SEARCH)
(North American Aviation-S & ID)

Let $F(X) = Y$ be any function and Y_{GOAL} be some desired point. Without requiring a user supplied initial value for X, SEARCH finds two values of the independent variable, X_L and X_H, such that $F(X_L) < Y_{GOAL} < F(X_H)$. The program then iterates by linear interpolation.

$$X_{new} = X_L + \frac{Y_{GOAL} - F(X_L)}{F(X_H) - F(X_L)} \quad (X_H - X_L)$$

If $\left| F(X_{new}) - Y_{GOAL} \right| > \varepsilon$, ε user supplied, the program reiterates, keeping the point bracketed, until $\left| F(X_{new}) - Y_{GOAL} \right| \leq \varepsilon$.

LANGUAGE: FORTRAN II

MACHINE REQUIREMENTS: IBM 7090/94

NUMBER OF CARDS: Approximately 60

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

DIANA: A Digital - Analog Simulation Program for the IBM 1620-II Computer
(Jet Propulsion Laboratory)

DIANA is a block oriented interpretive program for the IBM 1620-II computer useful for simulation of physical systems by solving the simultaneous differential equations which describe the systems.

The program is written in FORTRAN II-D printer format and requires 40-K memory 1311 disk drive, card read-punch, 1627 plotter with PLOT and CHAR subroutines (written in Symbolic Programming System), and a 1443 printer.

Use of the DIANA program has expanded and optimized input-output capabilities, provided additional flexibility in that program alterations can be made in "midstream" and continuing, and minimizes computational time through a choice of integration schemes which includes a variable step size adaptive routine and a method of handling discontinuous functions so as to minimize their effect on computation time.

LANGUAGE: FORTRAN II-D

MACHINE REQUIREMENTS: IBM 1620-II

NUMBER OF CARDS: Approximately 1550

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

NPO-10129

A Modal Combination for Dynamic Analysis of Structures
(Jet Propulsion Laboratory)

The response of a composite linear structure subjected to low frequency sinusoidal base motion of a restrained structure or subjected to frequency sinusoidal forces at points of a free structure is determined by this program. The intention in developing the program was primarily to determine the undamped modes of a composite structure and secondarily to get response of sinusoidal forcing functions, which were required for problems related to current testing practices and closed loop stability of autopilot controlled space vehicles. Models of components in forms of geometry, normal modes, frequencies, lumped masses, and elastic properties are required. Systems are developed from the components when the required compatibility with the composite is imposed.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 5,700

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

Calculation of Resonance Neutron Absorption In
Two Region Problems (The GAROL Code)
(General Dynamics)

GAROL computes effective group cross sections for the resolved resonances of a mixture of isotopes in a two-region cell. The program allows a choice of geometries and can accept an arbitrary table of escape probabilities. A Dancoff-Ginsberg correction may be used to account for shadowing effects in a tight lattice, and cross sections may be 1/V, constant, computed from Breit-Wigner resonance parameters, or given in tabular form. The mesh may be chosen at equal energy or lethargy intervals, proportional to the neutron velocity, or as an arbitrary table of values.

The method of solution is to solve two coupled integral equations which arise from a neutron balance in each region. These are solved numerically to obtain the flux spectrum in each region, as well as group cross sections for each region and for the cell.

An unusual feature of the program is that overlap of resonances of an individual resonance absorber and of mixtures of different resonance absorbers is treated exactly. Also, slowing down in all isotopes is computed exactly, so that the NR approximation need not be made for a heavy moderator.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 3,600

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $5.00

NUC-10049

A Digital Computer Program for the Steady-State Temperature Analysis of Plane or Axisymmetric Bodies (Aerojet-General Corporation)

This digital computer program using the finite element analysis technique has been developed to determine the steady state temperature distribution within plane or axisymmetric solids.

The continuous body is replaced by a system of triangular or quadrilateral elements. Each element is numbered. Each nodal point of each element is identified by its X and Y coordinate. Input into the program consists of nodal point identification, temperature or heat flow at boundary nodal points, material identification of each element, conductivity of each material, and convective heat transfer coefficient and temperature at each boundary nodal point. Each quadrilateral element is divided into four triangular elements. The conductivity matrix for each triangle is formed and then combined to form a 5 x 5 conductive matrix with respect to the five points. The 5 x 5 matrix is then reduced to the 4 x 4 quadrilateral conductivity matrix by standard techniques.

The quadrilateral conductivity matrix is then added to the conductivity matrix for the complete body. The nodal point temperatures are then found from the solution of the resulting matrix equations. Within the program this is accomplished by a large capacity matrix solver. All temperatures are then printed.

A particular feature of this program is that it provides output which is compatible for input to available finite element stress analysis programs.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

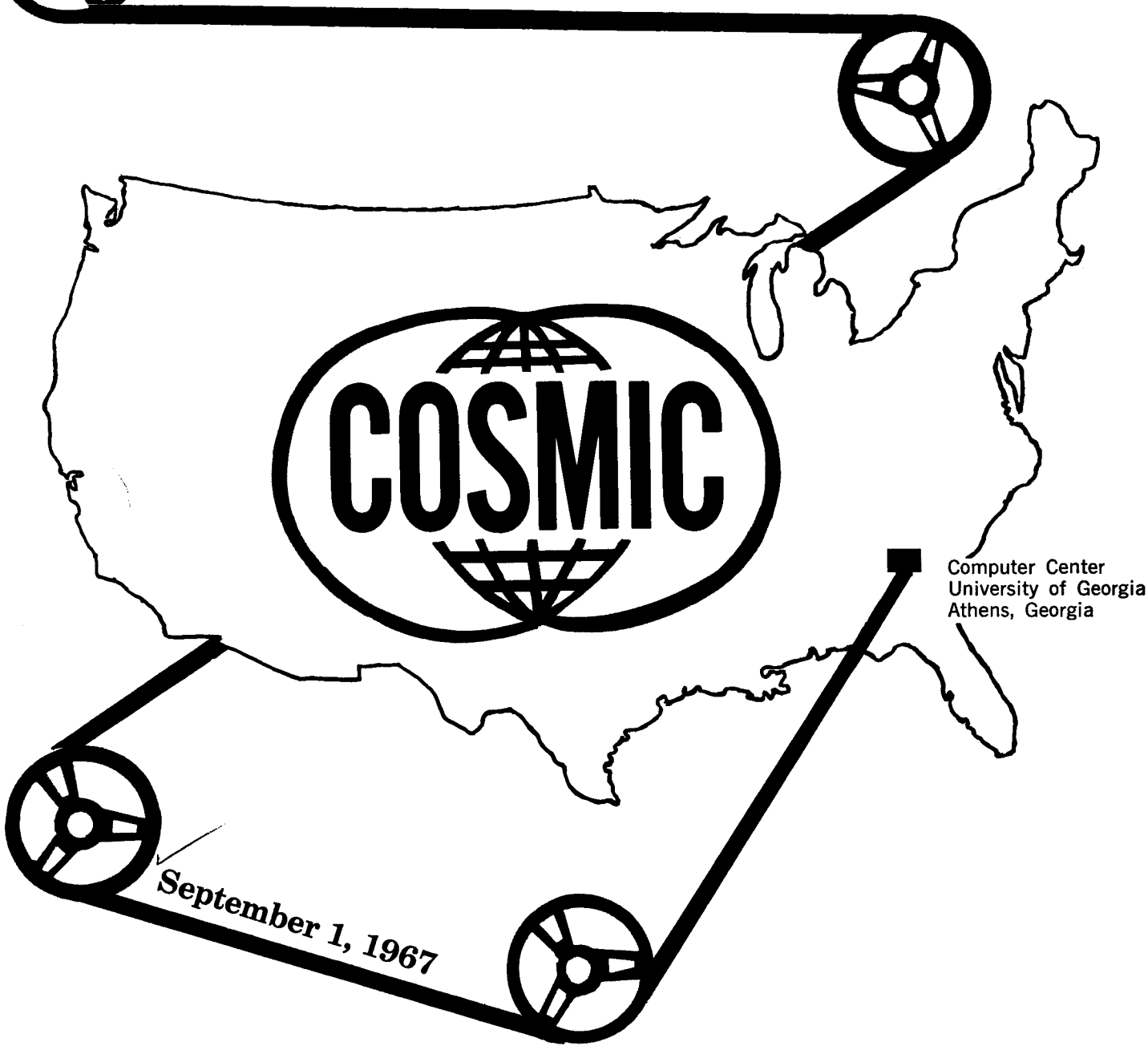
NUMBER OF CARDS: Approximately 750

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

DRP-3
2445

A Directory of Computer Programs Available from COSMIC



Computer Center
University of Georgia
Athens, Georgia

September 1, 1967

SUPPLEMENT 2 TO VOLUME 1

N O T I C E

This document was prepared under the sponsorship of the National Aeronautics and Space Administration. Neither the United States Government nor any person acting on behalf of the United States Government assumes any liability resulting from the use of the computer programs listed in this document, or warrants that such use will be free from privately owned rights.

KWIC INDEX

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These Programs Are Fully Operational And
Have Sufficient Documentation To Run

SMOG-Sales Management Organization Game
(University of Georgia)

SMOG was created as an aid in the teaching of sales force management. By limiting the game to just those factors which are important in the training of sales force managers, the player is afforded the opportunity to manage a sales force without having to make all other types of decisions related to the running of a total business.

The major elements of this game which were structured to be controlled by the player are salesman selection, hiring, firing, transferring and forecasting. Within each of these major decision areas there are such factors as when to hire, when to train, which training program to use, which territory to use, how many men per territory, how to evaluate performance, etc. Also, the game is structured to allow the referee to teach different methods of evaluating performance such as the contribution approach. The referee and student are furnished with ample information to evaluate performance and decisions.

Outputs from the program consist of reprints of decisions, master list of all results for the referee, profit and loss statements for the players, and the option of three types of plottings of results for referee and player.

LANGUAGE: FORTRAN IV, MAP

MACHINE REQUIREMENTS: IBM 7094 (Plotting is an option and is presently programmed for EAI-3500)

NUMBER OF CARDS: Approximately 3000

PROGRAM FEE: $200.00

DOCUMENTATION FEE: $10.00

NOTE: When ordering this program be sure to specify whether or not you want the plotting package for the EAI-3500 which is an additional 3000 cards, but will be included at no extra charge.

GSC-10142

A Numerical Least-Square Method for
Resolving Complex Pulse Height Spectra
(Goddard Space Flight Center)

This program determines the "actual" incident differential energy spectra from measurement of the pulse height spectrum. The pulse height spectrum is in truth a measurement of the interaction of the incident flux with a spectroscopic detector. The approach taken in this program is to try to infer the "actual" incident differential energy spectrum by correcting the measured pulse height spectrum for the instrumental smearing and geometric efficiency.

Both analytic transform and empirical matrix transform methods have been considered for performing this unsmearing. The analytic transform methods have been plagued by two problems. First, it has been difficult to describe the pulse height functions in closed analytic form and second, it has been difficult to obtain a unique solution. Because of these difficulties, the empirical matrix inversion technique is used in this program. This technique seems to overcome these difficulties by not requiring analytic descriptions of the pulse height function and by limiting the domain of solutions by imposing physical constraints.

Since an exact solution to this problem cannot be obtained, the most probable solutions are obtained using the linear least-square method.

LANGUAGE: FORTRAN II

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 1,300

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $12.50

Zero-Lift Wave Drag
(Langley Research Center)

Since the rule was formulated, and verified experimentally, that the transonic wave drag of an aircraft is essentially the same as the wave drag of an equivalent body of revolution having the same cross-sectional area distribution as the aircraft, attempts have been made to estimate aircraft wave drag by examining the equivalent body area distribution. It has been found that reasonably good wave-drag estimates can be made near a Mach 1 speed if the slender-body theory is applied to the aircraft area distribution. This procedure can be extended to higher speeds with good results by using the supersonic area rule to determine the equivalent body area distribution.

The object of this program is to compute the zero-lift wave drag of an entire aircraft including any combination of the following components: wings, body, pods, fins, and canard. Two optional aims of the program are to compute the external volume of the wings and to compute the axial area distribution of the wing equivalent body.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 1,370

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

Flutter Analysis Program Using Subsonic Kernel Program
(Langley Aeronautical Laboratory)

Current aircraft-design trends, such as the use of thinner structures and external stores on aircraft capable of very high speeds, have combined to diminish flutter safety margins and have, consequently, increased the need for greater accuracy in flutter prediction. As a result, both the structural and the aerodynamic aspects of the flutter problem should be treated by use of more realistic methods than by the beam-theory and strip-theory methods commonly employed in the past.

The program is based on a Rayleigh-Ritz, or modal, type of flutter analysis which takes into account three-dimensional structural and aerodynamic behavior. The flutter mode is approximated by a series of natural-vibration modes, and the aerodynamic forces corresponding to these modes are derived from subsonic lifting-surface theory, according to the kernel-function approach, for a finite wing oscillating in compressible flow.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: CDC 6,000

NUMBER OF CARDS: Approximately 761

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $5.00

LAR-10115

Lifting Pressure Distribution on
Warped Surface of Arbitrary Planform
(Langley Research Center)

Linearized supersonic wing theory is used to calculate the theoretical lifting pressure distribution on a warped wing of arbitrary planform, and to compute the wing's force coefficient variation with angle of attack. According to the concepts of linear theory, the wing is assumed to have negligible thickness, and to be approximately in the plane = 0. The trailing edge of the wing is defined as supersonic.

The problem solved is that of obtaining the lifting pressure distribution on a warped wing, and also the lifting pressure distribution on a flat wing having the same planform. The required solution of the warped wing's force coefficient variation with the angle of attack (on lift coefficient) is obtained through a superposition technique: the warped wing coefficients are obtained at a specified wing incidence, and also the coefficients of the flat wing having the same planform are computed. The characteristics of the warped wing at incidences other than that specified are obtained by an appropriate combination of warped wing data plus a flat wing increment.

In calculating the lifting pressure distribution, the program basically integrates, numerically, within the fore Mach cone from the field point.

LANGUAGE: FORTRAN Version 2.0

MACHINE REQUIREMENTS: CDC 6400/6600

NUMBER OF CARDS: Approximately 979

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

Optimization Program for Least
Drag on Wing of Arbitrary Planform
(Langley Research Center)

Linearized supersonic wing theory is used to find the combination of three loadings having lease drag on a wing of arbitrary planform. This is done by defining the camber surface required to support each of the three types of pressure distributions-a uniform load, a load which varies linearly chordwise, and one which varies linearly spanwise-determining the corresponding lift and drag coefficients, and then solving for the proportions of the three loadings which produce least drag for a given total lift. The camber surface and force coefficients corresponding to the optimum loading distribution are then computed.

The program basically integrates, numerically, within the fore Mach cone from the field point (x, y), the equation of the camber surface for a prescribed pressure distribution. In addition, the interference drag coefficients of the three loadings are computed.

LANGUAGE: FORTRAN Version 2.0

MACHINE REQUIREMENTS: CDC 6000 Series

NUMBER OF CARDS: Approximately 606

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

LAR-10118

Leading Characteristic Line Program
(Langley Research Center)

This program computes the leading characteristic line of a conical nozzle. The output is printed and punched on cards to be used as input to a program that calculates the characteristic network of a jet boundary (P-5430). The beginning flow angle between velocity and the x-axis (θ), the Mach number (M), a limiting Mach number, a Mach number increment and the pressure ratio (γ) are supplied. Other parameters are computed for each Mach number and the cards are punched to be used as input for the computer program which calculates the characteristics of a jet boundary.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 89

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

Static Pressure of an Incompressible Fluid Flowing in Radial Equilibrium-Case No. 2
(North American Aviation-Rocketdyne)

The accuracy of measurements is of prime importance in surveys behind an axial-flow rotor or inducer or in any rotating fluid. Probably the most difficult measurement to obtain accurately is that of the static pressure. Hub and tip radii, blockage factor, and density are taken together with total head and angle to calculate axial velocity and static pressure. Euler's equations of motion are applied in the solution. A numerical solution is used to solve for continuity. Two guesses as to axial velocity at the tip must be made. It has been found that the solution is sensitive to the two guesses of axial velocity. If for either or both guesses, no solution is found, several additional values should be tried before the solution is abandoned as impossible.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 120

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MALIS (Matrix Algebra Interpretive System)
(Boeing)

The Matrix Algebra Interpretive System (MALIS) was developed to efficiently solve matrix manipulation problems with a problem oriented language. Capabilities were included for real matrix manipulation problems with a problem oriented language. Capabilities were included for real matrix addition, subtraction, multiplication, transportation, inversion, eigenvalue and eigenvector evaluation, and input/output. A major objective was providing maximum problem size capability within the limits of core storage for each of the above operations. The capability to load additional compatible programs at execution time was also provided. With these capabilities and a matrix-oriented language, minimal turn-around time is experienced between problem acceptance and supplying of solutions.

Through the use of matrix-oriented input language, this program provides the capability to solve problems which are expressed in terms of standard matrix notation. The program interprets the input statements and makes use of certain described procedures to obtain the specified problem solutions. Detail information concerning the matrix-oriented language is provided in the documentation.

LANGUAGE: FORTRAN II
FAP

MACHINE REQUIREMENTS: IBM 7090

NUMBER OF CARDS: Approximately 7,311

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

An Indirect Method for Computing Extermal Rocket Booster Trajectories In An Inverse-Square Force Field
(Boeing Company)

The computer program "COVCSF" utilizes the implementation of indirect calculus of variations techniques for the numerical solution of extremal multistage rocket booster trajectories in an inverse-square force field. The booster is constrained to two-dimensional vacuum flight, and both the flight path and coasting arcs are optimized so that propellant consumption is a minimum.

The COVCSF program is applicable for any spherical gravitational source, however, weight units apply to the Earth.

A maximum of five stages is allowed. For a multistage trajectory, the COVCSF program automatically isolates on the appropriate transversality condition for two of the input modes to achieve the final state. Use of the coast switch function during any stage is optional. The number of coasts in the last stage may be limited. Any number of coasting periods are allowed in the previous stages. An analytical determination of the coasting periods is optional.

Integration takes place simultaneously for the nominal and four perturbed trajectories, providing variation of a maximum of four control parameters to achieve isolation. Isolation may be made on a maximum of four out of five final conditions.

Provision is included for stopping the trajectory on any one of six final conditions. If the stop value has not been reached at the staging time of the last stage, the trajectory is ended at that time. The trajectory is also ended if the mass of the vehicle will become negative on the succeeding integration interval. The results are used in any case, even though the desired stop value has not been achieved.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 2,493

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $10.00

Solution of Large Sets of Simultaneous,
Linear Equations with Banded, Symmetric Matrices
(North American Aviation-Rocketdyne)

This is a FORTRAN IV digital computer program to solve large systems of simultaneous, linear equations having banded, symmetric matrices. Problems are limited to those which have a bandwidth that is less than the number of equations. The program is not limited directly by the order of the matrix because the core storage is independent of the number of equations. Program flexibility is achieved by variably dimensioned arrays and by user selection of auxiliary tapes. As many as 6,000 equations with 5 right-hand vectors have been solved in less than 45 minutes. Accuracy results were to 11 significant figures.

This program has a wide range of applicability relating to the solution of large sets of simultaneously linear equations. It can be used to a great advantage in aircraft, automotive, marine, industrial (buildings, bridges, and structures), etc. enterprises.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 393

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

Iteration of Exact Heat Conduction Solutions
(North American Aviation- S & ID)

The program investigates one-dimensional heat conduction within a semi-infinite body with a fixed surface and no mass transfer or surface re-radiation.

The program was needed to calculate isotherm depths from the exact solutions of temperature as a function of depth and time. The rate of heat transfer to the surface is assumed to be a triangular pulse. These calculated isotherm depths will then be compared with those obtained from the trajectory synthesis method.

LANGUAGE: FORTRAN II

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 100

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MSC-0479

Generalized Integration Routine
(North American Aviation-S & ID)

This program is a general integration routine. The documentation to the integration routine is set up so that the routine is in the form of subroutine NTGRAT so that the programmer might set up more basic type programs while using the routine.

NTGRAT has a built-in starting procedure which uses a series of predictor-corrector formulas similar to (and in some cases identical to) the Newton-Cotes quadrature formulas. The interval of integration is variable, and is increased or decreased automatically by the subroutine. The variable step size gives the shortest possible machine time for the calculation of a complete problem while the accuracy is maintained at a level compatible with the accuracy specified by input to the subroutine.

LANGUAGE: FORTRAN IV, MAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 3,053

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

MSC-791

Logic Change Transactions for an
Electric Data Processing (EDP) System
(North American Aviation-S & ID)

The program is designed to provide a means of defining through input transactions the logic to be employed by the computer program for accomplishing any of a great number of possible types of repetitive change operations.

Once the one or two lines of input transaction data are provided the computer program accomplishes the operation wherever the logic conditions are fulfilled throughout the document. The program eliminates repetitive coding in numerous cases where simple logic can define the requirements for changing data lines throughout a document. Coding time and keypunch time are also virtually eliminated by the program.

Any industry handling a large amount of information that must often be modified can handle lists and specifications by electronic data processing. If there are identifying features within the data such as reference designations or the like, the EDP program can be written to allow the program users to define change requirements through input transactions for changes of a repetitive nature.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 2,830

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MSC-1119

Multiphase Chemical Equilibrium Composition
(North American Aviation-S & ID)

This program is designed for the calculation of equilibrium composition of a complex, multiphase chemical system such as the ablation products of an inorganic-reinforced plastic. The method is based on the concept of free energy minimization of the total system. It is very general and may find applications in a diversified area. The program is designed to cover a maximum of 12 elements in 80 gaseous and 15 condensed species. The elements currently included in this program are C, O, H, N, Si, A, Al, B, and Ca. The temperature range is 0 to 24,000 degrees K. Also, certain thermodynamic properties of the system are determined as by-products of the main calculations.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 1,600

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $5.00

Generalized One Dimensional Heat Transfer Program (GONED)
(Manned Spacecraft Center)

GONED meets the need for a more general one dimensional heat transfer program for predicting the transient structural temperature response of a vehicle during the nonablative phase of a mission to the moon or planets.

The numerical formulation of the equations describing the thermal response of the structure is such that an implicit solution has been obtained. This eliminates the need for a stability criterion as required by the explicit solution. This solution permits more efficient utilization of machines since short machine running time per problem is realized while maintaining accurate solutions.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094/40

NUMBER OF CARDS: Approximately 2,493

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $5.00

Space Trajectories Program
(Jet Propulsion Laboratory)

The Space Trajectories Program originated in the need to study trajectories of high precision formed by the transit of a space probe from the Earth to one of the three targets technologically feasible at present-the Moon, Venus, or Mars-under the influence of gravitational forces described by Newton's law alone. Although the major programming effort has gone into obtaining a solution for which the accuracy is consistent with the single-precision arithmetic used, and which requires a reasonable amount of computer time (about 30 seconds), the program may be used for study of general interplanetary flight where it is sufficient to include the bodies Sun, Venus, Earth, Moon, Mars, and Jupiter for their gravitational influence.

Since the program solves the equations of motion for the probe only, and ignores the negligible perturbations of the probe on the bodies, it is sufficient to obtain the positions and velocities of the bodies in the form of planetary and lunar ephemerides in some convenient reference frame. Since the coordinates have been traditionally referred to the Cartesian system based on the mean equator and equinox of 1950.0, the ephemerides used by the program have been uniformly expressed in the same coordinate system.

Since the planetary-position ephemerides are tabulated at four-day intervals and the lunar at one-day intervals on ephermeris tape, an interpolation scheme is included to obtain intermediate values of positions and velocities.

The equations of motion have been written to take advantage of the fact that usually a central body may be found, and the coordinates relative to that body expressed so that the dominant term in the acceleration arises from the chosen body, and the remaining terms are relatively small perturbations acting to displace the two-body orbit formed by the trajectory of the probe in the field of the central body alone. Thus the remaining gravitational bodies give rise to what is known as the n-body perturbation; the perturbation arising from the oblateness of the Earth and expressed by the second, third, and fourth harmonics is included when the probe is near the Earth; in a similar manner, the perturbation derived from the triaxial

(continued on next page)

figure of the Moon and represented through a second harmonic term is included when the probe is in the vicinity of the Moon. The above method of representing the equations of motion is known as a Cowell scheme. The solution to the trajectory problem is obtained by a stepwise numerical integration of the equations of motion.

For purposes of control, the trajectory has been divided into segments which are referred to as "phases." Usually a phase is characterized by a dominant central body, and integration step size is determined by the distance of the probe from that body.

The complete system which is recorded on eight reels of magnetic tape includes the Trajectory Monitor and the Space Trajectory Program, the Powered Flight Program, the JPL FORTRAN II version 2 monitor, auxillary programs, and a table of the n-body ephemeris (ephemerides).

LANGUAGE: FAP (FORTRAN II, Version 2 monitor).

MACHINE REQUIREMENTS: IBM 7090(4)

NUMBER OF CARDS: 8 reels of magnetic tape (available on tape only).

PROGRAM FEE: $500.00 for the complete system. $75.00 for the ephermeris data only.

DOCUMENTATION FEE: $15.00

NPO-10295

Reliability Math Model Using the Digital Computer
(Jet Propulsion Laboratory)

This program is designed to calculate the probability of system success from an arbitrary reliability block diagram (a functional diagram of the system showing the essential functions required for system operation). The program uses an algorithm that was developed using the probability tree method of calculating system success.

The program can be used as a very efficient design tool at the systems level. The probability of success for different blocks of the diagram may be varied in this program in order to see which has the most effect in the system. It is also possible to readily vary the block diagram to see which arrangements of the components, or blocks, is the most reliable. The program is also useful, once the design has been set, to calculate predictions for the system.

LANGUAGE: FORTRAN II

MACHINE REQUIREMENTS: IBM 1620, Monitor II

NUMBER OF CARDS: Approximately 250

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

A Computer Program for Calculating the Steady-State Fluid Dynamics of Coolants in Parallel Channels and the Temperature Distribution in the Surrounding Heat-Generating Solid (Westinghouse)

This computer program is designed to solve simultaneously the steady-state fluid flow and heat transfer analysis of a heat generating solid cooled by fluid flowing in parallel channels. The composite solution provides the fluid-flow distribution, temperature rise, and total pressure loss of the coolant, as well as the temperature distribution within the solid and the distribution of heat flux along the channel walls. The program can handle any of six different solid materials, various single-phase fluids, and up to 30 parallel channels having common inlet and outlet plenums.

LANGUAGE: Modified Version of FORTRAN II

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 5,000

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $10.00

Computer Program Provides for the Steady State Thermal and Flow Analysis of Multiple Parallel Channels in a Heat Generating Solid (Westinghouse)

This program has been developed to calculate temperature distributions in a heat generating solid. The program is general to facilitate the use of various parameters, such as film heat transfer correlations, materials, system configurations and gases. Features of the program include flow balancing in parallel channels, adjustments of power and determination of channel diameters of loss coefficients to meet specified exit conditions. A step change in pressure may be introduced at an intermediate axial distance and either the total flow rate or pressure drop across the heat exchanger may be specified. Three different power shapes and axial lengths may be used in any one problem.

LANGUAGE: Modified Version of FORTRAN II

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 1,500

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $5.00

Computer Program ETC Improves the Computation of the Elastic Transfer Matrices of the Legendre Polynomials P(0) and P(1) (Westinghouse Astronuclear Laboratory)

This program is used to calculate flux averaged elements of the P(0) and P(1) transfer matrices. The same quantities are calculated with ETC as are calculated with other programs, however, in deriving the equations for ETC, rather than carrying out a double integration numerically, one of the integrations has been carried out analytically and the numerical integration need only be carried out over one variable. This results in a more satisfactory numerical treatment, and also a faster calculation.

For identical input the program ETC takes about one-third of the time other programs take to calculate the P(0) and P(1) Kernels. This program has also been made more flexible, viz., any number (< 200) of energy mesh points may be used per GAM Groups, and the number may vary from group to group. This feature may be utilized to save additional computer time.

The program can be used by industries requiring double integration, or it can be used for the calculation of multigroup cross-sections for analysis of any nuclear reactor for any application.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094/CDC-6600

NUMBER OF CARDS: Approximately 654

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $10.00

FPIP-REV Computer Program Calculates Fission Product Inventory for U-235 Fission (Westinghouse Astronuclear Laboratory)

The Revised Fission Product Inventory Program (FPIP-REV) is written in FORTRAN IV for the CDC 6600 computer. This revised program utilizes a fission product nuclide library of 254 nuclides, reduced from 499 nuclides used in the original FPIP program. This reduction in the nuclide library plus other modifications has resulted in no significant change in accuracy of the program, but has markedly increased the efficiency of operations.

FPIP calculates the time behavior of 254 fission product nuclides formed by fissioning of U-235 resulting from a specified reactor operating history. The operating history can consist of as many as six separate operating periods, each at an arbitrary power level. The activity is calculated for each nuclide and summed for the total inventory. In addition the program calculates the gamma and beta radiation energy source strengths (mev/sec) in each of seven gama and five beta energy groups versus decay time after final shutdown. Also, for each decay time, the integrated gamma and beta source strengths (mev) per group are determined over a specified time span immediately subsequent to that decay time.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: CDC 6600

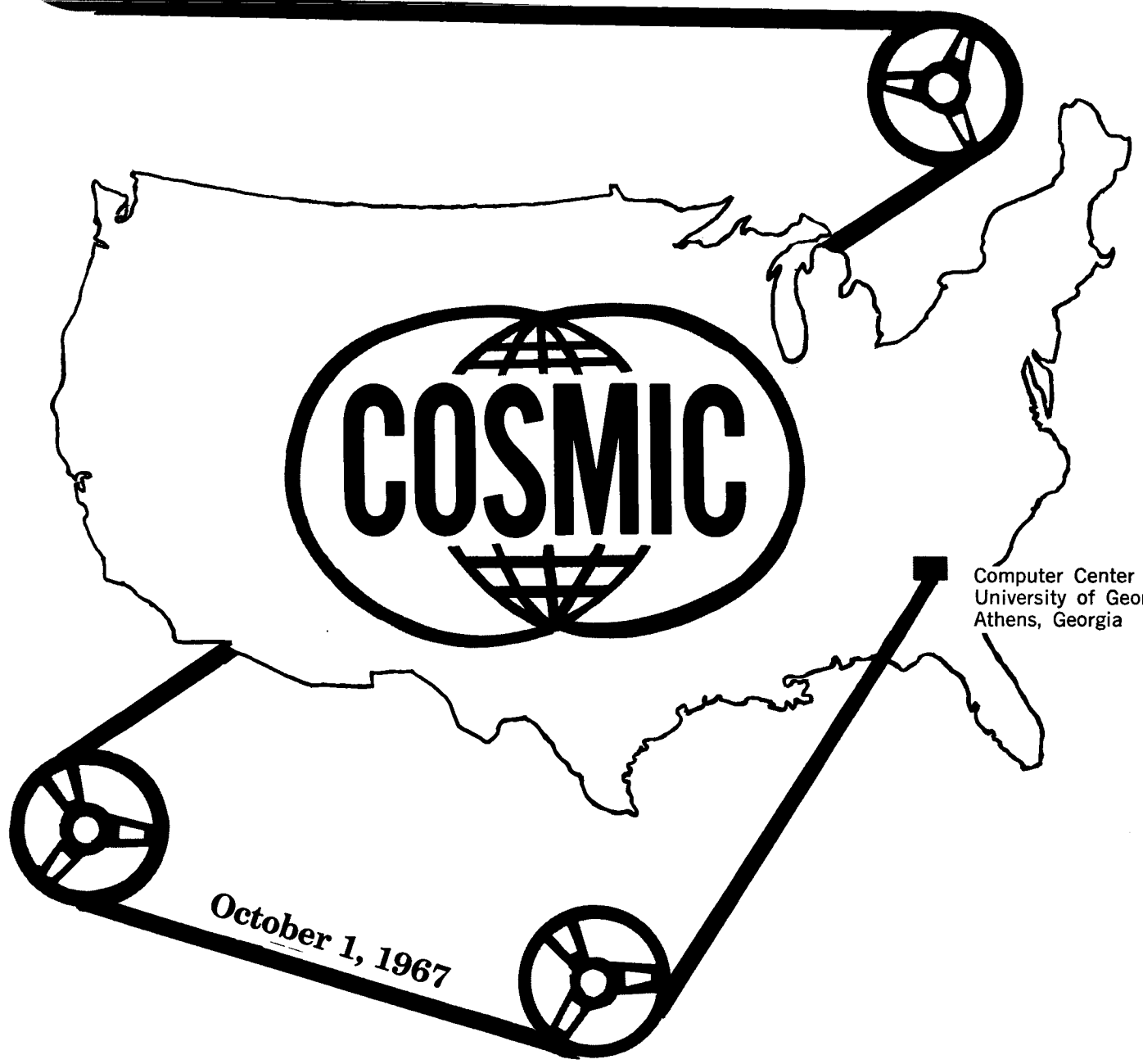
NUMBER OF CARDS: Approximately 1,522

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $5.00

T 41147

A Directory of Computer Programs Available from COSMIC



October 1, 1967

SUPPLEMENT 3 TO VOLUME 1

N O T I C E

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These Programs Are Fully Operational And
Have Sufficient Documentation To Run

WIGLE-40, A Two-Group, Time-Dependent Diffusion Theory Program for the IBM 7040 Computer (Phillips Petroleum Company)

WIGLE-40 is a one-dimensional, two-energy-group, time-dependent diffusion theory program for the IBM 7040 computer. It has been designed to calculate the space-time behavior of the neutron flux in a reactor during a transient. The program is restricted to one-dimensional slab geometry with zero gradient or zero flux boundary conditions. The number of delayed neutron groups may be zero, one, or six. Arbitrary time-dependent changes may be made in the parameters in the diffusion equations to introduce perturbations or feedback into the system. The basic equations can be interpreted as the conventional, two-group, time-dependent diffusion equations, or they can be used to describe the one-group behavior in two reactors coupled through their fluxes.

Provisions have been made for the program user to supply additional input data and arbitrary feedback equations. The feedback subroutine may be used to introduce arbitrary feedback equations. The feedback subroutine may be used to introduce arbitrary changes in the reactor parameters, either for inherent feedback or for other time-dependent variation.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7040

NUMBER OF CARDS: Approximately 1,000

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

University of Washington BASIC
Interpretive Compiler - UWBIC
(University of Washington)

This program is used for executing sets of instructions written in the BASIC language. UWBIC consists of a set of eight subroutines, written entirely in the FORTRAN IV language. The program accepts, as input, programs written in the BASIC language and data to be operated on by such programs. The output produced will be either (1) diagnostic messages indicating errors in the program written in BASIC or (2) output produced by following the instructions written in BASIC with the data provided.

UWBIC operates in two phases. The first phase (compilation) is performed by four subroutines (C1 through C4). These subroutines accept statements in the BASIC language, check their syntax, issue diagnostic messages if required and/or prepare equivalent instructions in a pseudo-machine language. If the compilation is successful, control is transferred to the four subroutines that perform the execution phase (E1 through E4). These subroutines simulate a computer with the instruction set defined by the pseudo-machine language; they execute the program directly, without extensive re-translation. UWBIC thus lies between true compiler systems and true interpretive systems, combining some of the advantages (and disadvantages) of each.

UWBIC is written entirely in a subset of the FORTRAN IV language as implemented on the IBM 7094. The subset utilized is sufficiently general that the system can be used with little or no alteration on virtually any medium-to-large-scale computer provided with a FORTRAN IV compiler. It is, therefore, as machine-independent as any system can be.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 2,200

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

LAR-10078

PRESTO, Program for Rapid Earth-to-Space Trajectory
(Lockheed)

The digital computer Program for Rapid Earth-to-Space Trajectory Optimization (PRESTO) uses a "closed loop" steepest descent optimization procedure to derive flight trajectories that produce maximum booster payloads for a variety of space missions. Trajectories can be computed in three degrees of freedom about a spherical rotating earth. Four powered stages and three upper stage thrust cycles are accommodated. Coast periods are permitted between each stage. Aerodynamic lift and drag forces are included in the computations.

Particular attention has been devoted during program development to computing speed. The convergence scheme, the general program arrangement and the subroutines have been selected with this in mind. In some cases standard subroutines have been modified to provide significant increases in speed for special applications. IBM 7094 computing times under one minute are currently being realized for complete three stage boost trajectory optimizations from the earth's surface to earth orbit.

The optimization routine simultaneously considers the launch direction and time, the interstage coast durations, the upper stage thrust sequencing, the complete pitch and yaw attitude histories and the terminal constraints. Intermediate constraints may be introduced on angle of attack, coast orbit perigee altitude or on the product of angle of attack and dynamic pressure. The closed loop procedure greatly facilitates the satisfaction of terminal constraints and reduces the number of iterations required to achieve convergence.

LANGUAGE: FORTRAN II

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 7,800

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $10.00

Analysis of D.C. Circuits (R1113)
(Langley Research Center)

ASAP (Automated Statistical Analysis Program) is a D.C. Circuit analysis program. In contrast to previous programs, ASAP does not require that the circuit equations be written and solved to produce a Monte Carlo statistical analysis. By using a nodal description of the circuit in English text free-format style, ASAP will write circuit equations, solve them algebraically, write and compile a FORTRAN subroutine, and run the statistical analysis. A considerable amount of programmer time can be saved and careless errors eliminated by this method.

The ASAP II program is composed of two parts. The first is also called ASAP and is designed and programmed to accept the user's simple topological description of his circuit, and the component parameter information, such as their nominal values, the tolerances and the type of density function that characterizes each component. The output of this program is another computer program which contains all the statistical information and mathematical models of the circuit and its nonlinear components. The second part of this program, STRESS, performs the statistical analysis.

LANGUAGE: FORTRAN IV, MAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 8,030

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $ 10.00

LAR-10154

Airplane Turbulent-Skin-Friction Drag
(Langley Research Center)

This program computed the skin-friction drag of an airplane, including the effects of distributed roughness and temperature of the surfaces, at arbitrary combinations of Mach number and altitude. Calculations can be made using either the standard day or the +10°C hot day atmospheres. Input consists of the flight conditions (M, Alt.), the wetted areas and reference lengths of all the components of the airplane and the mean roughness height and emittance of the surfaces.

LANGUAGE: FORTRAN IV,
MAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 680

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

A Computer Program for the Prediction of Flow Distribution in a Ring-Type Injectory
(North American)

The program was developed to predict the steady distribution of propellant flow in injectors. The program computes the orifice flow rates in any one particular ring.

The fundamental method of solution of the flow equations consists of multiple iteration of linearized versions of the characteristically quadratic energy relation with the characteristically linear continuity relation. The program for ring flow uses a simultaneous linearized matrix solution.

LANGUAGE: FORTRAN IV MAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 480

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

Statistical Analysis Program
(North American Aviation-Rocketdyne)

The Statistical Analysis Program uses statistical analysis to compute the mean, standard deviation, coefficient of variation, and lower tolerance limits of material property values. One guaranteed minimum value uses three standard deviations. The other uses a K value obtained from a table. The arithmetic mean, standard deviation, coefficient of variation, and two guaranteed minimum values can be calculated for sets of observations in which the frequency is greater than 1. The probability and confidence are not used in any calculations except in determining the value of K by table reference. U (units) is used to differentiate whether observations are in psi or ksi. In case of elongation, the percent is in U inches.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 80

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

Column Analysis Complex
(North American Aviation-Rocketdyne)

This is a FORTRAN IV digital computer program to evaluate the stability analysis of complex columns in the field of structures. Lateral deflection, internal moments, magnitude, position of the maximum ANC-5 interaction value, and the minimum margin of safety on each side of a pin-ended column are determined by this program. The effects of secondary bending assume external end moments cause bending in only one plane and that the axial loads act parallel to a straight line between the ends of the column. The centroidal axis is assumed straight before loading, but it may have a small parabolic warp which must lie in the plane of bending.

The three general types of problems which can be analyzed by this program are:

A. To determine the stresses, deflections, interactions, etc. for a specific column due to a single loading condition;

B. To determine the stresses, deflections, interactions, etc. for a specific column due to a constant end moment and an axial load which increases to the critical value of load or stress; and

C. To determine the stresses, deflections, interactions, etc. for a column of varying length with a constant end moment and a varying axial load.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 220

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

Column Analysis Simple
(North American Aviation-Rocketdyne)

This is a FORTRAN IV digital computer program of a specific purpose to perform a stability analysis of columns in the field of structures. The program determines the lateral deflections, the magnitude, and the maximum stresses in columns, including the effects of secondary bending. The column is assumed to have pinned ends, but it may have external end moments of eccentric axial loads. Axial forces must be applied at the ends of the column, within the plane of bending, and parallel to the longitudinal axis. The centroidal axis of the column is assumed to be a straight line before loading. Variable cross sections are allowed.

Output data consist of the magnitude and position of the column deflections, column moments, and maximum stress on each side of the column. In addition, the input data and the midpoint deflection at the next-to-final iteration are also printed out.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 190

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

Mass Optimal Solutions of Some Variable Endpoint Trajectory Problems
(The Boeing Company)

The calculation of trajectories is required for a variety of orbital problems such as orbit transfer, rendezvous, lunar transfer and lunar launch. In all cases optimization of trajectories for minimal propellant consumption is a prime concern.

This computer program employs initial and terminal coasting arcs in reducing variable end point trajectory optimization problems to fixed end point problems. Finite thrust is used and there is no restriction on the magnitude of thrust or on initial or final orbit characteristics.

The initial conditions and desired terminal conditions of a transfer trajectory can be specified in conventional orbital elements or in spherical coordinates so that the program calculates a trajectory between any two points in space defined by initial and final position vectors. The corresponding end point velocities are arbitrary. Calculations are accomplished in one process eliminating methods involving numerous computer runs.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094 or SRU 1107

NUMBER OF CARDS: Approximately 1,560

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $5.00

Convergence-Divergence Nozzle Contour
Optimization-Techniques Computer Program
(The Boeing Company)

This program is designed to accurately define the geometric shape of an axi-symmetric convergent-divergent exhaust nozzle. Specifically, it will define the nozzle wall contour necessary to yield optimum thrust based on the given criterion of the exit Mach number (specifying the Mach number is equivalent to prescribing a fixed nozzle length since this Mach number describes a posteriori, a unique nozzle length), ambient pressure and flow conditions in the immediate vicinity of the throat.

Isentropic flow is assumed and the variational integral of this maximizing problem is formulated by considering a suitably chosen control surface. The solution of the variational problem yields certain flow properties on the control surface, and the nozzle contour is constructed by the method of characteristics to give this flow.

LANGUAGE: FORTRAN IV, MAP

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 1,740

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $3.00

Self-Optimizing Conceptual Reliability Growth Model Program
(North American Aviation-Rocketdyne)

This program employs an iterative procedure to achieve optimized development plan in terms of system reliability, growth and development cost. The program is designed to self-optimize the reliability growth model. Start failures, mainstage failures or failure groups, durations, modes, number of tests, probability of correction and overstress factors are related to maximize reliability and testing utilization at minimum cost.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 450

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

Axial Velocity of an Incompressible Fluid
Flowing in Radial Equilibrium Case No. 3
(North American Aviation-Rocketdyne)

This program is designed to calculate the axial velocity of an incompressible fluid flowing in radial equilibrium. It is a modification of a previously written program (MFS-13221) to force the computer to calculate a constant axial velocity, particularly if the basic design of the axial-flow pump involves long blades. The program features an averaging technique that will give an axial velocity to an exact constant. It is assumed that the fluid head is constant regardless of blade length. From hub to tip, the flow is free vortex and the axial velocity is constant. The basic equation used in this free-vortex averaging technique is

$$2\int_{r}^{r_t} C_u^2 \frac{dr}{r} = 2g\left[H_t - H\right] - \left[C_{at}^2 - C_a^2\right] - \left[C_{ut}^2 - C_u^2\right]$$

where

C_u - tangential velocity, ft. per sec.
r - radius
g - acceleration of gravity, ft. per sec.
H - head, ft.
C_a - axial velocity, ft., per sec.
h - hub
t - tip

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 130

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

Stress Analysis of Belleville Springs
(North American Aviation-Rocketdyne)

This program computes deflections, membrane forces, bending moments, stress, and the load-deflection history for conical shells (Belleville Springs) of uniform thickness. The program uses a large deflection theory, and is not restricted to the range in which deflection is proportional to the load. Program limitations are: (1) the shell must be thin and shallow, (2) symmetric axial loads must be applied and reacted at the edges of the shell, and (3) no axial, radial, or rotational constraints can be enforced at either boundary.

Significant errors were found in the results of computation using prior methods. These errors have been overcome by this program.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 380

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

Subroutine CDINV--Matrix Inversion
(North American Aviation-Rocketdyne)

CDINV is a subroutine subprogram. The program function is a matrix inversion of a real symmetric positive definite matrix. The method of Cholesky (Cholesky decomposition square root) is employed to invert an n^{th} order, real, symmetric, positive definite matrix. Arithmetic operations are performed in double precision. The upper triangle of the matrix to be inverted must be stored by rows in a one-dimensional vector. This matrix is replaced by the inverse. This routine is significantly faster and more accurate than more general techniques.

LANGUAGE: FORTRAN H

MACHINE REQUIREMENTS: IBM 360

NUMBER OF CARDS: Approximately 180

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

MSC-11324

SCANNER, Extended Arithmetic Pre-Processor
(Manned Spacecraft Center)

SCANNER accepts statements written in a simplified FORTRAN-like language called EXATRAN (Extended-Arithmetic Translation) as input and supplies numric code ordered into a Polish string as output. Deconcatenation of the input string (the user's program read in on cards) is carried out through programmed logic, applying the grammatical rules of the language. Each symbol is given a numeric code according to a preset heirarchy of grammatic function with modifications made at the encounter of delimiters. These codes are then stacked in a standard Polish string order and made available for convenient handling by whatever type of interpreter of compiler is to follow. SCANNER is quite versatile due to the fact that no commitments are made in regard to storage allocation, definition of variables (single-location, multiple-location, pseudo-), of to difinition of operators. For this same reason, however, a special purpose interpreter and executor program must be written for each new application to make these decisions and definitions.

LANGUAGE: COMPASS

MACHINE REQUIREMENTS: CDC 3600

NUMBER OF CARDS: Approximately 1,260

PROGRAM FEE:$75.00

DOCUMENTATION FEE: $5.00

NPO-10131

A Linear Circuit Analysis Program (CIRCS)
(Jet Propulsion Laboratory)

CIRCS was written for the IBM 1620/1311 System. The program can solve a linear network containing a maximum of 15 nodes (excluding ground) and 45 branches. Transisters and diodes can be included in the network as linear models and a special data card allows the user to describe the base, collector, and β or G_m characteristics of the transistor. Mutual inductance is not considered. A Mandex Worst Case is available with the d-c program. The sensitivities computations in CIRCS gives the user a perspective as to the percentage effect that a particular input parameter has on a particular node voltage with respect to the remaining input parameters. Linear approximations for the differentials and integrals in the transient program are substituted, thereby reducing the system of differential equations to a system of algebraic equations.

LANGUAGE: FORTRAN

MACHINE REQUIREMENTS: IBM 1620/1311

NUMBER OF CARDS: Approximately 6,790

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $10.00

NPO-10218

A Computer Program for Simplifying Incompletely Specified Sequential Machines Using the Paull and Unger Technique (Jet Propulsion Laboratory)

This program mechanizes the Paull and Unger process of simplifying incompletely specified sequential machines. The Paull and Unger process is a method of reduction of the rows in a flow table. Hand computations of the Paull and Unger process are tedious and often computational errors result. The majority of the steps in the process are sufficiently well defined so that programming a digital computer to perform the process was feasible. Those steps in the process that require trial and error decision are left up to the program user who may enter these decisions into the computer on line via the typewriter.

The running of several typical design problems on the computer has shown the merit of the computer program both in design time savings and computational accuracy.

A typical sequential machine design problem is presented in the documentation for the program to show where the Paull and Unger process has application. Several examples are used to clarify the process and the computer algorithms.

LANGUAGE: FORTRAN II-D

MACHINE REQUIREMENTS: IBM 1620/1622 II

NUMBER OF CARDS: Approximately 660

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $5.00

JPL Facilities Utilization and Occupancy Survey
(Jet Propulsion Laboratory)

The JPL Facilities Utilization and Occupancy Survey has proven to be a useful administrative and management tool for both JPL and NASA. The wealth of information contained in these reports is helpful in the reassignment of space and as a guide toward the best utilization of available space. Density of occupancy is readily discernable and inequities can be corrected. This amount of detail eliminates all the unknown factors that can exist in a large organization; detail is used to the extent that it is useful.

The program is designed to identify the various uses of all offices, experimental laboratories, conference rooms, shops etc. and to provide information on the net area in each room as well as the number and classification of people occupying them. When the data is assembled, punched on IBM cards, and processed through the computer, a record which will include every room in every building or trailer at JPL and its satellite facilities in the Pasadena area is obtained.

The details available from these reports such as type of personnel, office space required, unsatisfactory space, etc. enables any industry to comply with appropriate standards and where deficiencies exist will assist the industry in correcting them. The industry can also plan for future needs by the aid of this program.

LANGUAGE: FORTRAN II

MACHINE REQUIREMENTS: IBM 1620

NUMBER OF CARDS: Approximately 2,000

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $15.00

NU-0044

Computer Program to Select Sizes of Structural Steel Columns
(NASA)

This is a working program that can be applied to a very practical problem, the design of column and baseplates for a multi-story structure. It is simple to apply and it gives results that provide a record that can be easily followed. Because of the saving of engineering man-hours, the design of steel columns for a structure can be delayed until the final load data is available. The size of structural steel columns under axial loads is determined at points of lateral support based upon the 1963 AFSC specifications. After completing the sizing of a particular column, the program determines the size of the baseplate needed for the column. Input data consists of the elevation of the application of the loads, the axial loads, and the type of steel. Output consists of the elevation of the load application, size of section needed at that elevation, the actual stress produced, the allowable stress, and the loads applied.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 250

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

Computer Program Computes the Critical Frequency of a Rotating Shaft or the Lateral Natural Frequency of a Beam (Aerojet-General Corporation)

The purpose of this program is to compute the critical frequency of a rotating shaft with rotary inertia and shear effect and the lateral frequency of a beam vibrating in plane motion. The analysis is identical in both cases.

The shaft or beam is divided into an arbitrary number of sections. Each section is selected so that there is a linear relation between the parameters (Deflection, Slope, Moment, Shear) of the two ends of each section. The parameters of two adjacent sections are also connected by a linear relation. This leads to a reduced transfer matrix from which the critical speed or lateral frequencies are obtained.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 1,260

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

Computer Program Determines the Critical Speeds of Uniform and Non-Uniform Continuous Shafts With Any Number of Supports (Aerojet-General Corporation)

The purpose of this program is to determine the critical speeds or the lateral vibrations of uniform or non-uniform continuous shafts with any number of supports.

The beam is represented by a system of lumped parameters in matrix form, using the matrix transfer method. The conditions at one end of the beam are related to those at the other end. The mass of each shaft is assumed to be concentrated at the middle with or without a spring support. The deflection, slope, moment, and shear of the left end are expressed in terms of those at the right end in matrix form. Based on static and dynamic equalibrium conditions similar matrices can be put together according to the structural system, and are reduced one by one to a single four by four matrix. Equating to zero the determinant yields the desired lateral frequencies or critical speed of the system.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 1,260

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50

NUC-10092

Computer Program Determines the Coupled Critical Speed of Rotating Machinery
(Aerojet-General Corporation)

The purpose of this program is to evaluate the critical speeds of a rotating machine coupled to its foundation.

The solution of this problem involves the equation of plane motions which leads to the finding of amplitudes of vibration as well as the coupled critical speeds.

The first step of the solution is to determine the uncoupled critical speeds of the rotating machine and the lateral natural frequencies of the foundation by any convenient method. Then these parameters will be coupled with the known amount of eccentricity of the rotor to form two sets of equations of motion, which lead to a single frequency equation. The coupled critical speeds as well as the amplitudes of vibration at any operational speed (other than the coupled critical speeds) can then be computed.

LANGUAGE: FORTRAN IV

MACHINE REQUIREMENTS: IBM 7094

NUMBER OF CARDS: Approximately 500

PROGRAM FEE: $75.00

DOCUMENTATION FEE: $1.50